VOL. 29, NO. 3 MARCH, 1952

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ANNUAL SUBSCRIPTION, UNITED STATES and CANADA $6.00. FOREIGN $6.50
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Publication Office: 1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

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and ARCHIVES *of*
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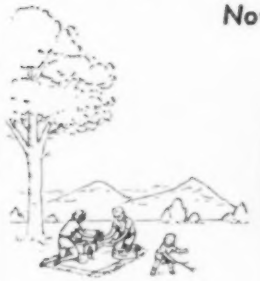

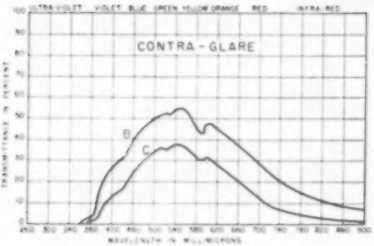

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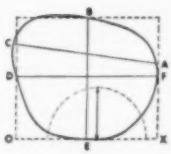

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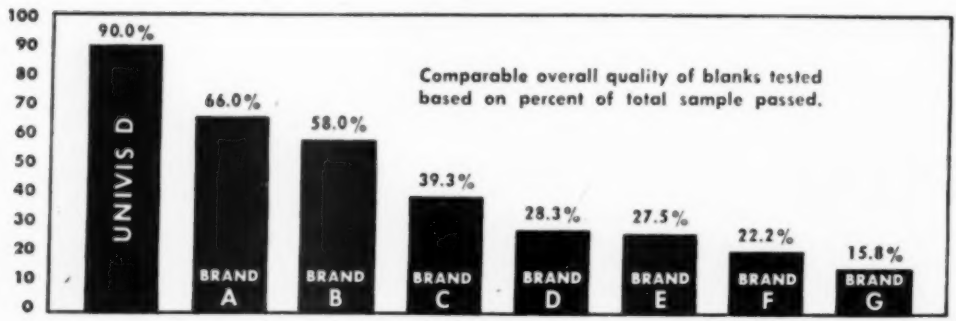

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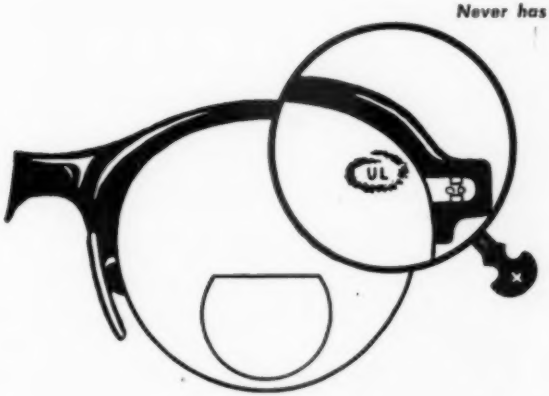

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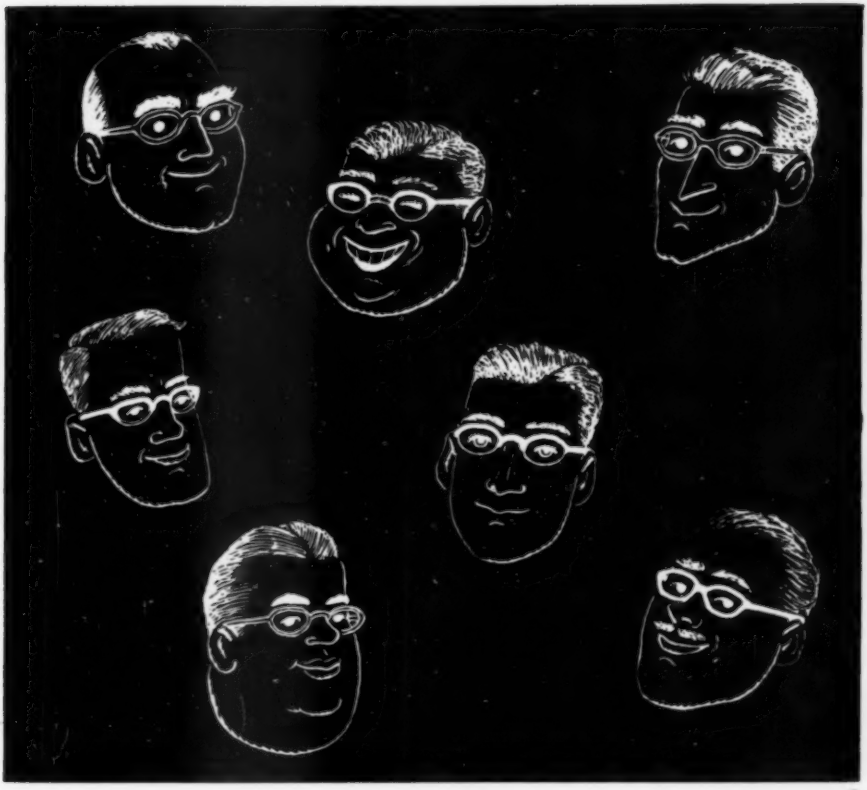

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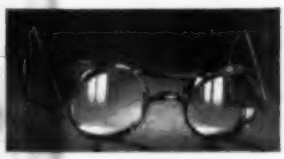
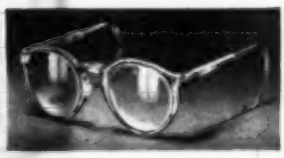


101 with Side Shields



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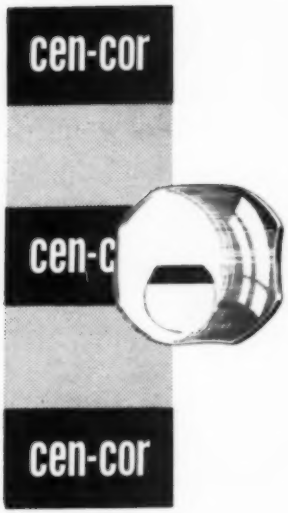

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SCOPE AND SIGNIFICANCE OF THE ACCOMMODATIVE UNIT*

Joseph I. Pascal†
New York, New York

The diopter, as a unit of lens power has now been generally adopted in ophthalmic optics everywhere. The same unit has also been introduced into physiological optics to denote the refractive power of the static eye and also to denote the additional power of accommodation. In the static eye the lens diopter as a unit of power is perfectly satisfactory, and we may well say that the refractive power of the schematic eye (Gullstrand's) is 58.64 D. But when the diopter is used as a unit of power in accommodation, we find numerous discrepancies. As a first approximation, it is true, the diopter may be used as a unit of accommodation, but for finer work it is not sufficiently accurate to be used as such.

Accommodation may be defined as the ability of the eye to increase its refractive power. This is positive accommodation; we shall omit from our present discussion negative accommodation though our thesis on the accommodative unit can be applied also to the latter. Now the accommodation as an expression of increase in power is somewhat different in the natural emmetrope as against the corrected ametrope. Let us take a natural emmetrope. When this emmetrope focuses sharply at 250 mm. from the eye, we say that he accommodates 4.00 diopters. This is perfectly correct, as the accommodative unit of the natural emmetrope is 1.00 D.

But it can be shown by calculations involving the conjugate foci relation that the corrected hyperope or the corrected myope who focuses sharply at 250 mm. from the eye does *not* accommodate 4.00 D. The corrected hyperope, he may be called a lens-emmetrope, accommodates *more* than 4.00 D. The corrected myope—he too may be called a lens-

*Read before the annual meeting of the American Academy of Optometry, New York, New York, December 8, 1951. For publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist and ophthalmologist. Fellow, American Academy of Optometry.

emmetrope—accommodates *less* than 4.00 D. This fact has been well known and has been discussed in many textbooks for generations. But the manner of calculating this change of power has been unsatisfactory.

Thus if a 5.00 D. hyperope, i.e., one corrected with a +5.00 Dv, focuses at 250 mm. from the eye, we may say that he accommodates 4.00 D. like the natural emmetrope. But this is just an approximation. We can show that he accommodates considerably more than 4.00 D. Similarly, if a 5.00 D. myope, i.e., one corrected with a —5.00 Dv, focuses sharply at 250 mm. from the eye, we may say that like the natural emmetrope, he accommodates 4.00 D. But here too this is just an approximation: we can show that he accommodates considerably less than 4.00 D.

To find the amount of accommodation the corrected hyperope or the corrected myope has to use for any given distance, the methods so far given involve some rather cumbersome calculations. Probably for this reason the use of the diopter as an approximate unit of accommodation has been generally used. But it is possible to find the amount of accommodation by any lens-emmetrope for any distance by a simple stratagem. It can be shown that every lens-emmetrope has his own accommodative-unit and by employing this unit the amount of accommodation used at any distance can be obtained, to a very close approximation, without any cumbersome calculations.

THE ACCOMMODATIVE UNIT DEFINED

The accommodative unit is defined as the amount of accommodation in diopters necessary to focus at a distance of 1 meter from the eye. At 50 cm. 2 units are necessary, at 33.3 cm. 3 units are necessary, at 25 cm. 4 units are necessary, and so on. For the natural emmetrope the unit is 1.00 D. For the corrected hyperope the unit is always more than 1.00 D. For the corrected myope the unit is always less than 1.00 D.

There are several expressions for the accommodative unit. The basic expression is $U = (1 - dL)^{-2}$ which is a neat way of writing $U = \frac{1}{(1 - dL)^2}$. U stands for the accommodative unit, d is the distance in meters between the second principal point of the correcting lens and the first principal point of the eye, and L is the power of the correcting lens in diopters. The distance "d" does not have to be calculated for, it can be taken directly, as will be shown later.

A simplification of the basic unit is $U = 1 + 2dL$,* which is perfectly satisfactory for all hyperopic cases and myopic cases (L is

*In natural emmetropia where the correcting lens L = zero, this reduces to U = 1.00.

minus) up to and including —5.00 D. The distance "d" may be taken as 20 mm. in the case of convex lenses and 15 mm. in the case of concave lenses. The vertex of a lens, as ordinarily placed before the eye is some 12.5 mm. from the cornea, and some 14 mm. from the first principal plane of the eye. In the ordinary convex lens, the second principal point of the lens is some 5 to 8 mm. in front of the vertex of the lens. So that the total distance from P_2 of the convex lens to P_1 of the eye is some 19-23 mm., and 20 mm. can be taken as sufficiently close. In concave lenses since P_2 of the lens is very, very close to the vertex, d may be taken as 15 mm.

In convex lenses, therefore, U = 1 + 2 x .020 L, whence U = 1 + .04 L, or simply U = 1 + 4% of L. This means that the accommodative unit of the corrected hyperope is 1.00 plus 4 per cent of the power of the correcting lens. Say L = +3.00 (a 3.00 D. hyperope), U = 1 + 4% of 3 = 1.12 D. Say L = + 4.00, then U = 1 + 4% of 4 = 1.16 D. Say L = +5.00, U = 1 + 4% of 5 = 1.20 D.

If L is minus, then from the expression U = 1 + 2d L, U = 1 + 2 x .015 L, whence U = 1 + 3% of L, and as L is minus, U equals 1.00 *minus* 3% of L. Thus if L = —3.00 (3 D. myope), U = 1 —3% of 3 = 0.91 D. If L = —4.00 (4.00 D. myope), U = 1 —3% of 4.00 = 0.88 D. If L = —5.00, then U = 1 —3% of 5 = 0.85 D. Taking L only as a numerical figure (without reference to its sign) then (1) U = 1 + 4% of L, when L is plus, and (2) U = 1 —3% of L when L is minus.

Thus how much does a 3.00 D. corrected hyperope accommodate for focusing at 25 cm. from the eye? His accommodative unit, write it A. U. or simply U = 1 + 4% of 3 = 1.12 D. At 25 cm., he requires 4 units, therefore he accommodates 4 x 1.12 = 4.48 D. Or how much accommodation does a 5.00 D. corrected myope use when focusing at 33⅓ cm.? His unit is A. U. or U = 1 —3% of 5, equals 0.85 D. At 33⅓ cm. he requires 3 units, therefore he accommodates 3 x 0.85 = 2.55 D.

For myopia above 5.00 D. the above expression for the unit is only grossly approximate. We therefore use another expression for the unit for myopia of over 5.00 D. namely (3) $U = (1 - 2dL)^{-1}$, or since 2d = 0.03 = 3%, we have (4) $U = (1 - 3\% \text{ of } L)^{-1}$, which can also be written as (5) $U = \frac{1}{1 - 3\% \text{ of } L}$. L must be taken with its proper sign, then the denominator comes out 1 *plus*

something. Since the unit in myopia is always less than 1.00 D. the denominator in (5) must be *more* than 1.00. This acts as a check on using the proper sign after the 1.00.

This relation can be remembered as a variation of (1). For all plus powers, $U = (1 + 4\% \text{ of } L)^1$. For minus powers up to and including —5.00. $U = (1 + 3\% \text{ of } L)^1$, (i.e., to the first power). For minus lenses above —5.00, $U = (1 - 3\% \text{ of } L)^{-1}$. The sign of the *exponent* changes from plus 1.00 to minus 1.00, and the sign *between* the terms is the same as that of exponent, thus $U = (1 + 3\% \text{ of } L)^1$, (to the plus 1.00 power), and $U = (1 - 3\% \text{ of } L)^{-1}$ (to the minus 1.00 power). L must be taken (algebraically) with its proper sign.

Thus, say, how much accommodation does a 10.00 D. corrected myope use when focusing at 250 mm. from the eye? At 250 mm. he needs 4 accommodative units. $U = [1 - 3\% \text{ of } (-10)]^{-1}$, or $U = \frac{1}{1 + 3\% \text{ of } 10}$, $\therefore U = \frac{1}{1 + .3} = 0.77$ D. Four units equals 4 x 0.77 D. therefore he accommodates 3.08 D., not 4.00 D. as would be said if we disregard his myopia.

There are numerous applications of the accommodative unit of which I will mention only two. Take a case of anisometropia. Say the right eye takes +1.00 D. the left eye takes +4.00 D. How does this patient accommodate for near vision? It is generally accepted that the two eyes accommodate to the same extent, that is with reference to the neuro-muscular phase of accommodation. Unquestionably the results of equal efforts may not be the same in the two eyes, say, e.g. in marked sclerosis of one crystalline lens. But the innervational element is equal in the two eyes.

Now the accommodative unit of the R. E. is $U = 1 + 4\% \text{ of } 1 = 1.04$ D. The accommodative unit of L. E. is $U = 1 + 4\% \text{ of } 4 = 1.16$ D. When the eyes want to see clearly at 25 cm. the right eye needs to accommodate 4 units, equals 4.16 D. The left eye has to accommodate 4 units, equals 4.64 D. As the eyes cannot accommodate 4.16 in the right eye and 4.64 in the left eye, they must do one of three things. (1) If the right eye sets the pace, then both eyes accommodate 4.16 D. which leaves the left eye under-accommodated by 0.48 D. (2) The left eye sets the pace, then both eyes accommodate 4.64 D. which makes the right eye over-accommodated by 0.48. (3) They accommodate an intermediate amount, say, 4.40 D. then each eye is 0.24 D. out of focus.

Solution No. (3) is probably most common since for all ordi-

nary near tasks it is not necessary to be in sharpest focus. It has been said that in general the eyes accommodate enough to accommodate the mind. But for very fine work this does not hold. The manner in which such eyes accommodate can be sometimes detected by the bar reading test. If the eyes use method No. 3 there will be no break in reading as each eye takes up fixation. But where the eyes use method 1 or 2 there will be a slight break or hesitation when the eye which is out of focus adjusts itself to come into focus. The test is partly vitiated by the fact that if the eye with the smaller accommodative unit sets the pace for fine focusing the other more hyperopic eye may see the print well enough even under a slight blur because of the greater magnification. The same observations of course hold good in myopia, anisometropia and more so in antimetropia.*

A similar analysis will show the difficulties in accommodation occurring in corrected astigmatism. Astigmatism is essentially anisometropia between the different meridians of the same eye. Thus suppose an eye takes a +1.00 D. sph. $\bigcirc$ +3.00 D. cyl. axis 90 for distance. We have here a condition where the vertical meridian is 1.00 D. hyperopic and needs +1.00 D. for correction and the horizontal meridian is 4.00 D. hyperopic and needs +4.00 D. for correction. Each meridian has its own accommodative unit and for focusing at 25 cm. from the eye each meridian needs 4 units.

The accommodative unit of the vertical meridian is 1.04 D. and that of the horizontal meridian is 1.16 D. Barring sectional accommodation, the two meridians must accommodate to the same extent. Here too, we have 3 possibilities. (1) The vertical meridian sets the pace whereupon the horizontal meridian is 0.48 D. under-accommodated. This explains the need for a stronger plus cylinder at near. Or (2) the horizontal meridian sets the pace, whereupon the vertical meridian is over-accommodated by 0.48 D. and likewise shows more astigmatism at near. Or (3) the eye accommodates an intermediate amount thus keeping both meridians slightly out of focus.

Most likely different eyes behave differently, and the same eye may behave differently under different seeing conditions. But the application of the accommodative unit to the two principal meridians enables us to study the change in astigmatism at near for any fixation distance.

THE UNIT AS AN AID IN SOLVING PROBLEMS

An interesting application of the accommodative unit is the ease

*The eye which sets the pace for the accommodation at near may properly be called the dominant eye, certainly so at near. This may thus be applied as a test for determining which is the dominant eye.

with which certain problems can be solved with its aid. Take this example. If a 4.00 D. corrected myope accommodates 1.50 D. for what distance from the eye is he focused? As a first approximation we may say, disregarding his myopia and treating him as a natural emmetrope, that he is focused for a distance of 667 mm. from the eye $(\frac{1000}{1.50})$.

But for a mere accurate finding we proceed as follows: His accommodative unit U = 1 — 3% of 4, whence U = 0.88 D. The number of *units* he accommodates is 1.70 $(\frac{1.50}{.88})$ i.e. he accommodates 1.70 units, which corresponds to a distance of 588 mm. $(\frac{1000}{1.70})$. Between the approximate finding and the more accurate finding is 79 mm. (667 - 588) which is an error of about 12 per cent.

Or take a 4.00 D. corrected hyperope. When he accommodates 1.50 D., for what distance from the eye is he focused? Here again the approximate finding is 667 mm. More accurately we say, his accommodative unit, U = 1 + 4% of 4 = 1.16 D. The number of *units* he accommodates is 1.30 $(\frac{1.50}{1.16})$. This corresponds to a distance of 770 mm. $(\frac{1000}{1.30})$. The difference between the approximate finding and the more accurate finding is 103 mm. (770-667), which corresponds to an error of about 15 per cent.

New concepts like new inventions need new names. These have to be coined and may sound strange at first. After a while they naturally become part of the language, thus the term "kodak" coined by Eastman.

For the accommodative unit I propose the term "Acmete" which is a condensation of *a*ccommodation and *meter*. It stands for the amount of accommodation required at a distance of 1 meter from the eye.

The value of the "Acmete" in diopters varies with the refractive condition, very much like the value of the meter angle in degrees varies with the interpupillary distance. This variation, however, does not impair its general usefulness.*

*The power of L. in the formulas for the accommodative unit is the vertex power as lenses are ordinarily marked now. In deriving the formula the *principal* power was generally used, as is usual in calculations involving conjugate foci. However, the difference is very slight and may be disregarded.

THE LENS REQUIRED TO REPLACE SOME OR ALL OF THE ACCOMMODATION

I want to take up one more point, that is, the strength of the lens which is required to replace a given amount of accommodation. This may be *all* the accommodation required for the fixation distance, or a part of the accommodation used requiring some residual accommodation for accurate focusing. Say a natural emmetrope accommodates 4.00 D. for distance of 25 cm. from the eyes. What lens will replace all his accommodation? As a first approximation we say 4.00 D. But careful calculation shows that it takes more than a +4.00 D. lens to replace all his accommodation.

In general, there are three methods for working problems of this kind in natural emmetropia and in corrected ametropia. One is what I call the "direct equivalence" method where we figure a +1.00 D. lens is the equivalent of 1.00 D. of accommodation. Thus in the above example, he has to accommodate 4.00 diopters, therefore a +4.00 D. will replace all his accommodation. Or if it were asked what lens will replace 1.00 D. of his accommodation or 2.00 D. of his accommodation, we would say a +1.00 D. lens and a +2.00 D. lens respectively.

This is the least accurate method since this equivalence disregards the role of lens effectivity and also treats the corrected ametrope the same as the natural emmetrope.

A second method is what I call "average equivalence" which takes into account lens effectivity but disregards the difference in accommodative effort at different stages of accommodation. This method gives more accurate results than the first, and is the one recommended for general use. These two methods require no formulas, as will be shown in a few examples.

The third method, and the most accurate (within the realm of approximations inevitably connected with this kind of calculation) is by the use of a formula. This formula method will be described last.

To find the replacing lens for *all* the accommodation used for any fixation distance in all cases we can get accurate results without any formula. We simply divide the "corrected" fixation distance into the key number. By the "corrected" fixation distance I mean the distance as measured from the lens (some 15 mm. in front of the eye) and not from the eye. Thus for a fixation distance of 25 cm. or 250 mm. from the *eye* the corrected fixation distance equals 235 mm. (250—15) which gives us +4.26 D. $\left(\frac{1000}{235}\right)$. This +4.26 D. is the replacing lens for *all* the accommodation necessary at 250 mm. from the eye in

the natural emmetrope and also in the corrected ametrope.

It can be seen why L' to replace *all* the accommodation is the same for all refractive conditions. L' may be thought of as the lens placed next to L, the correcting lens. As L' makes the light from the fixation object parallel the correcting lens L will do the rest and will make the light focus on the retina without any accommodation. L' makes the light from the object parallel without any regard for the value of L, therefore L' (the lens which replaces *all* the accommodation necessary for the fixation distance) is the same for all refractive conditions.

Thus what lens will replace *all* the accommodation required by a 3.00 D. corrected hyperope, or a 3.00 D. corrected myope for accurate focusing at 20 cm. from the eye? The given distance from the eye is 200 mm., the "corrected" distance from the lens is 185 mm. and the replacing lens is + 541 D. $\left(\frac{1000}{185}\right)$.

To find the amount of the accommodation used at any fixation distance by the corrected ametrope of course we have to use the accommodative unit. This will show how the same power lens replaces different amounts of accommodation in the different cases. Thus the natural emmetrope needs 5.00 D. of accommodation for a fixation distance of 200 mm. from the eye. The +5.41 D. replacing lens, replaces 5.00 diopters of accommodation.

The 4.00 D. corrected hyperope has an accommodative unit of 1 + 4% of 4 = 1.16 D. At 200 mm. he needs 5 units, therefore he accommodates 5 x 1.16 = 5.80 D. The + 5.41 D. lens replaces here 5.80 D. of accommodation. The 4.00 D. corrected myope has an accommodative unit of 1 — 3% of 4 = 0.88 D. At 200 mm. he needs 5 units, therefore he needs 5 x 0.88 = 4.40 D. In this case the + 5.41 D. lens replaces only 4.40 D. of accommodation.

TO REPLACE PART OF THE ACCOMMODATION

Say what lens will replace 2.00 D. of accommodation in a natural emmetrope focusing at 200 mm. from eye? We first find the lens L' which replaces *all* the accommodation, by the "corrected" distance method as shown before. Denote the replacing lens by L'. L' comes out to be + 5.41 D.

Thus in natural emmetropia, focusing at 20 cm. (1) Accommodation required is 5 units = 5.00 D. (2) Replacing lens for *all* accommodation = + 5.41 D. Therefore a + 1.00 D. lens replaces 0.92 D. of accommodation $\left(\frac{5.00}{5.41}\right)$ on the average. And 1.00 D.

of accommodation is replaced by a + 1.08 D. lens. Therefore to replace 2.00 D. of accommodation requires a lens of 2 x 1.08 = 2.16 D., that is, L' = + 2.16 D.

Or what lens will replace 2.00 D. of accommodation in a 4.00 D. corrected hyperope focusing at 200 mm. from the eye?

We find his accommodative units, U = 1.16 D., thus (1) accommodation required is 5 units = 5.80 D., (2) replacing lens for *all* accommodation = + 5.41 D., accommodation = 5.80 D., lens = 5.41 D. Therefore a + 1.00 D. lens replaces 1.07 D. accommodation ($\frac{580}{5.41}$), and 1.00 D. of accommodation is replaced by a + 0.93 D. lens ($\frac{5.41}{5.80}$). Therefore to replace 2.00 D. of accommodation requires a lens of 2 x 0.93 D. = 1.86 D., that is, L' = + 1.86 D.

Or what lens will replace 2.00 D. of accommodation in a 4.00 D. corrected myope, focusing at 200 mm. from the eye? We find his accommodative unit, U = 0.88 D. Thus, (1) accommodation required is 5 units = 4.40 D., (2) replacing lens for *all* accommodation = 5.41 D., accommodation = 4.40 D., lens = 5.41 D. Therefore a + 1.00 D. lens replaces 0.81 D. of accommodation ($\frac{4.40}{5.41}$), and 1.00 D. of accommodation is replaced by a + 1.23 D. lens ($\frac{5.41}{4.40}$). Therefore to replace 2.00 D. of accommodation requires a lens of 2 x 1.23 = 2.46 D. that is L' = + 2.46 D.

GIVEN A LENS TO FIND ITS REPLACING EFFECT

A related but somewhat different problem runs as follows. Given a natural emmetrope focusing at 20 cm. from the eye, (a) how much accommodation will be replaced by a + 3.00 D. lens put before the eye? Also (b) what is the residual accommodation necessary for exact focusing through the + 3.00 D. lens?

Of course by the "direct equivalence" method we would say that he needs 5.00 D. of accommodation to focus at 20 cm. A + 3.00 D. lens will relax or replace 3.00 D. of accommodation and the residual accommodation required is 2.00 D. This is grossly approximate.

By the "average equivalence" method we found before for the natural emmetrope, that (1) accommodation required at 20 cm. = 5.00 D., (2) replacing lens for all accommodation = 5.41 D. A

+ 1.00 D. lens replaces 0.92 D. accommodation, and 1.00 D. of accommodation is replaced by a + 1.08 D. lens. Therefore the + 3.00 D. lens will replace 3 x 0.92 D. accommodation which equals 2.76 D. of accommodation. Since the total accommodation required is 5.00 D., the *residual* accommodation through the + 3.00 D. lens is 2.24 D. (5.00 — 2.76).

Similarly, given a 4.00 D. corrected hyperope focusing at 20 cm. from the eye, (a) how much accommodation will be replaced by a + 3.00 D. lens put before the eye? And (b) what is the residual accommodation necessary for exact focusing through the + 3.00 D. lens?

By the "direct equivalence" method we would get the same answers as for the natural emmetrope as given above, namely 3.00 D. and 2.00 D., respectively.

By the "average equivalence" method we proceed as follows. We found before that for the 4.00 D. corrected hyperope, focusing at 200 mm., (1) the accommodation required is 5 units = 5.80 D., (2) the replacing lens for all accommodation = 5.41 D. We also found that a + 1.00 D. lens replaces 1.07 D. accommodation, and 1.00 D. accommodation is replaced by a + 0.93 D. lens. Therefore the + 3.00 D. lens will replace 3 x 1.07 D. accommodation which equals to 3.21 D. of accommodation. Since the total accommodation required is 5.80 D. the residual accommodation through the + 3.00 D. lens is 2.59 D. (5.80 — 3.21).

Similarly given a 4.00 D. corrected myope focusing at 20 cm. from the eye, (a) how much accommodation will be replaced by a + 3.00 D. lens put before the eye? And (b) what is the residual accommodation necessary for exact focusing through the + 3.00 D. lens?

Here, too, by the direct equivalence method, as shown above, the answer would be 3.00 D. and 2.00 D., respectively.

By the "average equivalence" method we proceed as in natural emmetropia and in corrected hyperopia. We found before that for the 4.00 D. corrected myope focusing at 200 mm., (1) the accommodation required is 5 units = 4.40 D., (2) the replacing lens for all accommodation = 5.41 D. We also found that a + 1.00 D. lens replaces 0.81 D. of accommodation, and 1.00 D. accommodation is replaced by a + 1.23 D. lens. Therefore the + 3.00 D. lens will replace (relax) 3 x 0.81 D., which equals 2.43 D. of accommodation. Since the total accommodation required is 4.40 D. the *residual* accommodation through the +3.00 D. lens is 1.97 D. (4.40 — 2.43). Table I shows some of the differences as found in the different refracting conditions.

FORMULA METHOD

I mentioned that the third and most accurate method (within limitations) of solving the problem on the power of the replacing lens is by a formula. This simple, general formula is $L' = \frac{A}{U - d\,A}$. In this formula L' stands for the replacing lens. A stands for the *total* amount of accommodation required at the fixation distance, and also for the *residual* accommodation required through a plus lens which does not replace *all* the accommodation. U stands for the accommodative unit of the case considered. And "d" is the distance from the lens to the eye in meters, and is regularly taken as 0.015.

In the natural emmetrope where U = 1.00, the formula reduces to $L' = \frac{A}{1 - d\,A}$ which is seen at once as another way of writing the lens effectivity formula. However, it is best to use the one general formula, good for all cases, viz. $L' = \frac{A}{U - d\,A}$. The formula can be used to find the lens which replaces *all* the accommodation at any fixation distance for emmetropia and corrected ametropia. But this is found more easily by the corrected "distance" procedure shown before, and the formula need not be used for that. It should be used, if one is interested in more accurate answers for finding the lens which replaces *part* of the accommodation, and for finding the amount of accommodation replaced by a given lens, and also the residual accommodation necessary through such a lens.

TABLE I.

Fix. Dist.		Lens	Lens to replace	Amount of acc. replaced by a	Residual acc. necessary through the
200 mm. from eye.	Total acc. required.	to replace all acc.	2.00 D. of acc.	+3.00 D. lens.	+3.00 D. lens.
Natural Emmetrope	5.00 D.	5.41 D.	2.16 D.	2.76 D.	2.24 D.
4.00 D. corrected hyperope	5.80 D.	5.41 D.	1.86 D.	3.21 D.	2.59 D.
4.00 D. corrected myope	4.40 D.	5.41 D.	2.46 D.	2.43 D.	1.97 D.

This is illustrated in the ensuing examples. A special feature of working with the formula is the light it throws on the accommodative

power as the same amount of accommodation in diopters is replaced, but at a different level.

Thus, say, to replace part of the accommodation of the natural emmetrope in focusing at 250 mm. from the eye, we proceed as follows: For focusing at 1 meter from the eye he needs 1.00 D. of accommodation. The lens to replace this accommodation can be obtained from the formula $L' = \frac{A}{U - d\ A}$, or simply by dividing 985 into 1.000 which gives us 1.02. When this natural emmetrope focuses at 250 mm. from the eye, he accommodates 4.00 D. To replace 1.00 D. of accommodation *now* means to find the lens which together with the 3.00 D. of accommodation he still uses will focus the light coming from 250 mm. from the eye. The diopter of accommodation to be replaced now is the *fourth* diopter the patient has to use. And for finding the replacing lens for the 4th diopter, we cannot use the method employed for finding the replacing lens for 1.00 D., when this was all the accommodation he used (for a 1 meter distance), call it the first diopter of accommodative activity.

For our present purpose we have to use two steps, (1) find the replacing lens for *all* the accommodation, and (2) find the replacing lens for the accommodation still used, that is the "residual" accommodation. The difference between the two gives us the value of the replacing lens for the 1.00 diopter of accommodation at this level. Thus in our example, L' for all the accommodation (4.00 D.) is + 4.26. L' for the 3 D. of accommodation he still has to use (after applying the replacing lens to permit him to relax 1.00 D. of accommodation) is $L' = \frac{3}{1 - .015 \times 3}$, which gives L' = + 3.14 D. The *difference* between L' for *all* the accommodation and L' for *3 D.* of accommodation still in use, gives us the replacing lens for 1.00 D. (the fourth D) of accommodation. Therefore L' = 4.26 — 3.14 = 1.12 D. That is, it takes a + 1.12 D. to replace 1.00 D. of accommodation when the patient still has to use 3.00 D. of accommodation.

Similarly, to replace 2.00 D. of accommodation of this natural emmetrope focusing at 250 mm. from the eye, we first find the *residual* accommodation. This is 2.00 D. (4.00 — 2.00). We now find by the formula L' for A = 2.00, that is the amount of residual accommodation he still has to use. This gives us L' = + 2.06 D. Therefore L' to replace the 2.00 D. of *relaxed* accommodation is 4.26 —2.06 = + 2.20 D. Similary, to replace 3.00 D. of accommodation for this

natural emmetrope so that he will be using only 1.00 D. we get L' = $\frac{1}{1 - .015 \times 1}$, which gives us L' = + 1.02 D. Therefore L' to replace 3.00 D. of relaxed accommodation equals 4.26 — 1.02 = + 3.24 D. In all cases A in our formula is the amount of accommodation the patient still *uses* (the residual accommodation) not the amount he can *relax* after applying the replacing lens.

To sum up, in our natural emmetrope focusing at 250 mm. from the eye we find that:

(a) It takes + 1.12 D. to replace the 4th D. of accommodation.
(b) It takes + 2.20 D. to replace the 3rd and 4th D. of acc.
(c) It takes + 3.24 D. to replace the 2nd, 3rd and 4th D. of acc.
(d) It takes + 4.26 D. to replace the 1st, 2nd, 3rd & 4th D. of acc.

Analyzing our finding we see that

To replace the 4th D. of accommodation we need a + 1.12 D. lens.
To replace the 3rd D. of accommodation we need a + 1.08 D. lens.
To replace the 2nd D. of accommodation we need a + 1.04 D. lens.
To replace the 1st D. of accommodation we need a + 1.02 D. lens.

We see here that the replacing lens increases in power as it tends to replace the more and more difficult part of the accommodation. The accommodative unit thus follows the physiological trend of the accommodation as it certainly takes more neuro-muscular effort to accommodate the 2nd diopter than the first, and still more to accommodate for the 3rd diopter, the 4th diopter, and so on.

PROCEDURE IN CORRECTED AMETROPIA

Exactly the same procedure is followed in corrected ametropia. The U in the formula instead of being 1.00 (for the natural emmetrope) has the value corresponding to the ametropia.

Thus for example what lens will replace 3.50 D. of accommodation of a 5.00 D. corrected hyperope when focusing at 20 cm. from the eye? Solution. At 20 cm. he needs 5 accommodative units. His unit is U = 1 + 4% of 5, U = 1.20. Five units equals 6.00 D. Denote by A' all the accommodation he needs. Use A' and A'' (A prime and A second) for better identification.

To replace all the accommodation, we have

$$L' \text{ (for A')} = \frac{6}{1.20 - .015 \times 6}, \text{ whence L' (for A')} = + 5.41 \text{ D.}$$

(This value we can also get from $\frac{1000}{185}$ which gives us 5.41 D.).

To replace 3.50 D. of accommodation in the sense that the patient can *relax* that amount we must find the amount of accommodation which he still has to use, which is 2.50 D. Call it A'', the residual accommodation. L' (for A'') $= \frac{2.50}{1.20 - .015 \times 2.50}$, whence L' (for A'') $= +2.15$ D. This would replace the accommodation still to be used. To replace the accommodation to be *relaxed* (the 3.50 D. asked for) we must take the difference. Thus L' (for A') $= +5.41$ D. L' (for A'') $= +2.15$ D. Therefore L' (for the 3.50 D. to be replaced) $= +3.26$ D.

Or take a 4.00 D. corrected myope, what lens will replace 3.00 D. of his accommodation (that is, permit him to relax 3.00 D. of accommodation) when focusing at 20 cm. from the eye? At 20 cm. (200 mm.) he needs 5 units. His unit is U $= 1 - 3\%$ of $4 = 0.88$ D. Five units equals $5 \times 0.88 = 4.40$ D. That is, the accommodation necessary at that distance is 4.40 D. Call this A' $= 4.40$ D. To replace *all* the accommodation we have L' (for A') $= \frac{4.40}{.88 - .015 \times 4.40}$, whence L' (for A') $= +5.41$ D. The same result can be obtained from $\frac{1000}{185} = 5.41$ D. After replacing 3.00 D. of accommodation (allowing him to relax 3.00 D.) he will still have to accommodate $4.40 - 3.00 = 1.40$ D. This is the *residual* accommodation. Call it A''. The replacing lens L' (for A'') $= \frac{1.40}{.88 - .015 \times 1.40}$, whence L' (for A'') $= +1.63$ D. This would replace the accommodation which has still to be used after relaxing 3.00 D. of accommodation. Therefore the lens to replace the accommodation to be *relaxed* (the 3.00 D. asked for) is $5.41 - 1.63 = 3.78$. That is, it would require a $+3.78$ D. lens to permit our myopic patient to relax 3.00 D. of accommodation when focusing at 20 cm. from the eye.*

The general method for problems of this kind using the formula $L' = \frac{A}{U - d\ A}$, is (1) Find L' to replace all the accommodation necessary for the fixation distance, what we termed A'. This can

*To replace 3.00 D. of accommodation in a 4.00 D. corrected myope requires a $+3.78$ D. lens and not a $+3.00$ D. lens as is frequently said, and which is admissible only as a very rough approximation. The above method gives a very much closer approximation.

also be found more easily without a formula, as was shown by the "corrected" distance method. (2) Find L' to replace the *residual* accommodation necessary for the fixation distance, what we termed A''. Then the difference, i. e. L' (for A') —L' (for A'') = L' for the *relaxed accommodation*.

The formula can also be used for finding the amount of accommodation replaced (or relaxed) and the amount of residual accommodation still necessary when a plus lens of any given power is placed before the eye.

SUMMARY.

The diopter as a unit of lens power is not suitable as a unit of accommodative power, except as a rough approximation and except in the natural emmetrope. Every corrected ametrope has his own accommodative unit which may be expressed in several ways. The most convenient expression is U = 1 + 2dL, which simplifies to U = 1 + 4% of L for all corrected hyperopes, and U = 1 − 3% of L for corrected myopes up to −6.00 D. In the simplest terms, the accommodative unit in corrected ametropia equals 1 + 4% of L (the correcting lens) when L is plus, and 1 − 3% of L (L taken numerically) when L is minus. Thus if L is + 5.00, U = 1 + 4% of 5 = 1.20 D. If L is minus, (− 5.00 D. or less), say, L = − 4.00, U = + 3% of (− 4) = 1 − 3% of 4 = 0.88.

For myopia over 5.00 diopters the unit is $U = (1 - 2dL)^{-1}$ or $U = \frac{1}{1 - 2dL}$ which simplifies to $U = \frac{1}{1 - 3\% \text{ of } L}$, L being taken with its minus sign, or $U = \frac{1}{1 + 3\% \text{ of } L}$, L being taken numerically.

Several applications of the unit are discussed, e.g. the process of accommodation in anisometropia, the change in astigmatism at near as determined by the use of the unit, the variable power of the lens which can replace all or part of a patient's accommodation, the place of the unit as a physiological unit of accommodation in conformity with the change of power of the replacing lens, and so on.

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DISCUSSION

FRANKLIN A. SEWARD, New York City:

This concept of an accommodative unit is an ingenious idea which has many theoretical and practical bearings. Everyone of us, of course, always knew that the diopter used to measure changes in the accommodation of a corrected ametrope was

only approximately correct. In many cases the approximation, indeed, was very rough. But the calculations involved in figuring out the true amount of accommodation used were much too involved, especially for the vast majority of us who have been out of school for many years.

Pascal's method is really simplicity itself. All we do is to find the number of units of accommodation required at the fixation distance by dividing the distance into the proper number, e.g. cm. into 100, mm. into 1 000 and so on, then multiply this number by the value of the unit. The unit is simply 1 plus 4% of the correcting lens power if the lens is plus and 1 minus 3% of the correcting lens power if the lens is minus. In minus lenses, of 6.00 D. and over, we simply take for the unit the reciprocal of 1 minus 3% of the lens power.

I am especially intrigued by the application of the accommodative unit for determining the changes in astigmatism from distance to near. This is by far the simplest method I have yet seen for calculating this change. But there is more to the accommodative unit than Pascal has given us in his paper today. For example, I have read somewhere how by means of the accommodative unit the true amplitude of accommodation can be distinguished from the apparent amplitude as determined by the near point of accommodation. I trust that Pascal will tell us on some other occasion of some of the other applications of the accommodative unit.

The exposition of how to calculate the power of the replacing lens in accommodation in terms of the accommodative unit is a very interesting approach to a practical problem. The idea of a physiological unit of accommodation which increases in power as the higher diopters of accommodation are called into play is a stimulating idea. I wish to congratulate Pascal on the presentation of a really novel and useful concept in physiological optics.

ANNOUNCEMENT

AMERICAN ACADEMY OF OPTOMETRY SECTION APPOINTMENT

SECTION OF OCCUPATIONAL OPTOMETRY

President Harold Simmerman announces the following appointments to the section on occupational optometry:

Dr. Richard Feinberg, Chairman, Northern Illinois College of Optometry, Chicago, Illinois. Dr. C. S. Bridgman, Director, Bureau of Industrial and Applied Psychology, University of Wisconsin, Madison, Wisconsin; Dr. Herman Sager, Director, Eye Service, Sperry Gyroscope Company, Inc., Great Neck, Long Island, New York; Dr. R. M. Hall, Cleveland, Ohio; Commander R. Rosswell Sullivan (MSC), U.S.N., Professional Division, Bureau of Medicine and Surgery, Washington, D. C.; Dr. L. M. Wheless, High Point, North Carolina; Dr. John Wittekind, Morrisville, Pennsylvania; Dr. D. A. Springer, Anniston, Alabama.

The consulting committee to the section on occupational optometry is as follows:

Mr. R. A. Sherman, Occupational Vision Department, Bausch & Lomb Optical Company, Rochester, New York; Dr. Paul Boeder, Director, Bureau of Visual Science, American Optical Company, Southbridge, Massachusetts; Mr. Sylvester Guth, Director, Lighting Research Department, General Electric Company, Nela Park, East Cleveland Ohio, and Dr. W. J. Heather, American Optical Company, Southbridge, Massachusetts.

RELATION OF REFRACTIVE FINDINGS TO MENSES*

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The question of the importance of menses relative to refractive error is one that is sometimes raised among practitioners. Isolated cases have been cited that tend to indicate changes in refractive status can occur in relation to the menstrual cycle. The following study was undertaken in an attempt to determine how important this factor may be in routine optometric practice.

EXPERIMENTAL PROCEDURE

Seven young women employed at the college served as subjects. Table I gives the pertinent information regarding each. All subjects were tested Monday, Wednesday and Friday, between 8:30 a. m. and 9:30 a. m. for a period of five consecutive weeks. During the five-week period all of the subjects reported general good health. This was substantiated by daily measurements of weight and body (oral) temperature, which showed no significant variations or trends. The temperature measurements were not sufficiently precise to pick up the small variation in body temperature with ovulation reported in other studies.

The optometric tests were limited to a set of static retinoscope findings in the principal meridians of one eye, and the measurement of monocular visual acuity through two empirically selected auxiliary spherical lenses supplementary to each subject's habitual prescription.

The static retinoscopy was measured in the following manner. A working distance lens was added to each subject's correction, if any. The observer then varied the working distance, recording the distance in centimeters at which "against" motion was first observable and again the distance at which "with" motion could just be detected. This was done in both principal meridians and the mean spherical equivalent determined by averaging the reciprocals of the four readings thus obtained. The data so obtained were combined with the mean spherical dioptric value of the glasses worn, if any, and the value of the working distances lenses, to give the "static refraction." For example, a subject wearing glasses with formula +1.00 —.50 x 90, scoped through the

*Read before the annual meeting of the American Academy of Optometry, New York, New York, December 8, 1951. For publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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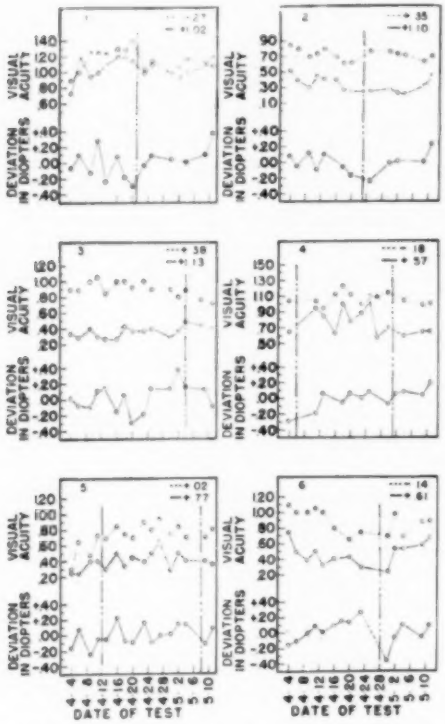

Fig. 1. Graphical Representation of Acuity and Refraction Data from Six Subjects with Normal Menses.

The horizontal scale represents the dates on which the measurements were made. The lower half of each vertical scale is in tenths of diopters representing variations of the static refraction values from the "mean static refraction." Plus values represent increases toward hyperopia, and minus values represent changes toward myopia. The upper half of the scale is in visual acuity decimal units indicating the acuity as measured through lenses added to the lens correcting the "mean static refraction." The vertical lines running through each graph indicate the first day of menstruation.

On several of the testing dates measurements were not taken on one or more of the subjects. In no case was this due to illness associated with menstruation, but rather to colds, scheduling conflicts, vacations, etc.

prescription and a +1.50 working distance sphere, with "neutralization" points at 72 and 63 centimeters in the vertical meridian and 58 and 54 centimeters in the horizontal meridian would have a static refraction of

$$+ 0.75 + 1.50 - \frac{\frac{1}{.72} + \frac{1}{.63} + \frac{1}{.58} + \frac{1}{.54}}{4} = + 0.61 \text{ Diopters.}$$

The "mean static refraction" was obtained by averaging the static refraction values obtained during the five-week period.

Visual acuities were measured with the aid of a Landolt Ring Slide in a Clason Visual Acuity Meter with the screen at a distance of five meters. The acuity was measured first with a —0.25 sphere combined with the habitually worn glasses, if any, and then with a +0.50 sphere combined with the habitually worn glasses. These values were selected somewhat empirically because it was impossible to predict exactly what the "mean static refraction" would be until the series was completed. It was hoped that these two choices of lenses would represent in some of the cases, at least, a small addition of minus and a small addition of plus in combination with the distance correction.

In Figures 1 and 2 these lens additions are represented in terms of additions to the hypothetical correction of the "mean static refraction" instead of the habitually worn glasses. In the preceding example the —.25 and +.50 spheres would be represented as additions of —.11 and +.64 diopters respectively to the lenses which would correct the "mean static refraction." For example, —.25 sphere added to the subjective spherical equivalent of +.75 results in a spherical value of +.50 which is 0.11 diopters less plus or minus add to the calculated "mean static refraction" of +0.61. Similarly, a +.50 added to the subjective spherical equivalent of +.75 totals +1.25 diopters which is the equivalent of a +.64 add over and above the calculated "mean static refraction."

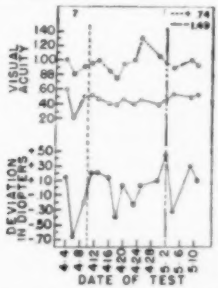

Fig. 2. Graphical Representation of Acuity and Refractive Data of Subject with Irregular Menses. See Fig. 1 for explanation of scales. The first vertical line (dashes) indicates the twenty-eighth day from the previous normal menstruation. The second vertical line indicates the date of occurrence of vicarious menstruation.

RESULTS AND DISCUSSION

Six of the subjects gave reports of normal menstrual cycles. The seventh subject demonstrated irregular menstruation. The incidental data for all seven subjects are presented in Table I. The experimental

TABLE I.
Summary of Data Pertaining to the Seven Subjects Investigated. All information except that based on the actual measurements described, is as reported by the subjects.

Subject	1	2	3	4	5	6	7
Age	26	25	23	26	40	31	23
Married	No	Yes	Yes	Yes	No	No	Yes
No. of Days in Cycle	28	28	30-34	29	25	25-26	Varies
Dysmenorrhea	Yes	No	No	Yes	Yes	Yes	Greatly Occasionally
Eye Tested	OD	OD	OD	OD	OD	OS	OD
Amount of Astigmatism	.25	.00	.75	.00	1.25	.00	.50
Mean Static Refraction for the 5-week Period	—.77	—.60	—.88	—.07	—1.27	+.14	—2.49

results of the six subjects are graphically represented in Figure 1. The results obtained on subject No. 7 are shown separately in Figure 2.

The lower half of each graph shows the variation in tenths of diopters from a zero point which represents the "mean static refractive state." This point was determined by finding the mean of all the retinoscopy findings for each subject accumulated during the five weeks testing period as previously described.

All except one of the subjects showed more minus or less plus in the "mean static refraction" than was indicated either in their habitually worn glasses or in the refractive records previously on file in the college clinic. Subjects Nos. 1, 2, 3, 4, 5 and 7 showed more minus under the experimental conditions than was shown by the retinoscope findings on their clinic records by .40, .60, .26, .07, .15 and .49 diopters respectively. Subject No. 6 showed .14 diopters more plus. The average difference for all seven was 0.26 diopters more minus by the experimental retinoscope procedures. All subjects except No. 6 showed minus "mean static refraction" under the conditions of the experiment whereas the clinic records would indicate subjects Nos. 2, 4 and 6 to be emmetropes.

The reason for this discrepancy is not obvious, though a number of factors may be suspected. For one thing the time interval between clinic tests and the experiment would favor the direction of change shown if there were any real physiological changes involved. Secondly, in clinical work there is continuously more striving to obtain the maximum possible plus, whereas in the experimental work the measurements were made without clinical prejudice. Thirdly, and this may be the most important factor, the difference in procedure and criterion for determining

neutrality may be involved. The experimenter in this procedure employed both the "with" and "against" transition points to ascertain the neutral zone, whereas in clinical procedure examiners characteristically employ the best single estimate of "neutrality." In any case, the average difference of only 0.26 diopters is probably not a factor that would influence the inferences of this present analysis.

As may be seen by inspection of the retinoscopic graphs there was considerable variation from the "mean static refraction" in each case. The range of variation was at a minimum of 0.46 diopters in subject No. 5 and a maximum of 1.10 diopters in subject No. 7. The fact that the range of variation was so consistently close to about a half diopter in the six cases alone suggests that this may be due to ordinary measurement error. Accordingly, it may be suspected that the wider variation in subject No. 7 was real. Subjects Nos. 1, 2, 5, 6 and 7 showed minima or curve dips at or near the time of menses. Subject No. 4 showed a minimum at one menstrual period and an intermediate value at the other. Subject No. 3 showed a maximum or peak near the times of menses. In no instance however, was the minimum (or maximum) clearly isolated or significantly identified with the menstrual period. Except for No. 7, the static refraction during these periods did not deviate from the "mean static refraction" more than about 0.30 diopters. Only in two instances (Nos. 3 and 7) were measurements made on the first day of menstruation. One of these approached a maximum and the other reached a maximum on that date.

The acuity findings, represented in the upper halves of the graphs in Figures 1 and 2, show practically no correlation with the day to day variations in refraction. Subject No. 1 shows a maximum at or about the time of menstruation. Subject Nos. 2, 4, 5, 6 and 7 show minima at or about the time of menstruation. Variation in subject No. 3 shows no apparent relationship to the menstrual cycle. Inasmuch as these acuity findings are taken through plus lenses they should be expected to vary with changes in refraction. The failure of the acuity findings to vary in correlation with day to day variations in refractive findings substantiates the previous suspicion that the day to day variations in refractive findings were experimental errors, but the occurrence of so many minimum acuity values at or about the time of menstruation makes reasonable the suspicion of real changes toward myopia during the menstrual period. (The possibility of other physiological changes influencing acuity cannot be disregarded, although their discussion is not within the scope of this paper.) The magnitude of the acuity reduction during these periods suggests something less than 0.25 diopters of change.

Subject No. 7 gave a history of very irregular menstrual periods, with frequent occurrence of vicarious menstruation. The vertical broken line in Figure 2 indicates the 28th day from the last preceding normal menstruation. While neither normal nor vicarious menstruation occurred at this time, it is interesting to note the marked increase in minus simultaneous with the drop in visual acuity through plus lenses. The solid vertical line indicates the date at which the subject experienced a vicarious menstrual period (nose bleed). On that day the retinoscope showed an increase in plus followed by a sharp increase in minus, although the visual acuity through plus failed to show an accompanying drop.

CONCLUSION

In the seven subjects investigated there seemed to be no consistent variation that would serve as a basis for predicting the effect of menses on refraction. Such variations as do occur seem typically to be of less than 0.25 diopters in the direction of more myopia, or less hyperopia, at or about the time of menstruation. The limited number of subjects investigated does not preclude the possibility that there are hyper-reactive individuals, who demonstrate significant changes with menses.

THE PRESENCE OF NEGATIVE ACCOMMODATION IN CERTAIN SUBJECTS*

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Translated by
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Comptes rendus des séances de l'Academie des Sciences, *230*, 1422-1424, April 12, 1950.

Experimental demonstration by skiascopy, is made of negative values of accommodation (up to 3 D.). Like the positive values, the negative ones come from the crystalline lens and are reduced by atropinization.

The dioptrics of the human eye, subject to the approximation of Gauss, rests on the following bases: the crystalline lens is the sole agent of accommodation, that is to say of the faculty which the eye has of projecting on the retina the clear image of objects situated at different

*Read before the annual meeting of the American Academy of Optometry, New York, New York, December 10, 1951. For publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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distances. The ciliary muscle by traction on the zonule modifies the curvature of the crystalline lens and controls accommodation. When the ciliary muscle is at rest, the radii of the curvature have their maximum value and the point conjugate to the retina constitutes the *punctum remotum*. As the ciliary muscle contracts, the lens increases its curvature, the power of the eye is augmented, and the point conjugate to the retina is brought up to the *punctum proximum*, which corresponds to the maximum value of accommodation. The eye is said to be emmetropic when its far point is at infinity, hypermetropic when it must accommodate even to see at infinity, and myopic when its far point is at a finite distance before the eye. In the latter instance the subject is always blurred for distance, the minimum blur occurring in the absence of accommodation.

This classic theory is based on the conception of a static far point which is characterized by a complete relaxation of the ciliary muscle. We have already shown[1] that this concept is not accurate and that the natural relaxation may differ (up to 2 D. difference) from the forced relaxation produced by atropine which paralyzes the ciliary muscle. The classical theory assumes that the cycloplegic destroys the natural *tonus* of the muscle.

Certain observations have shown us that this idea of a static far point should be revised. We have noticed that numerous subjects, naturally myopic or made so by convex lenses, can decrease the blur of the distant image, not by half-closing the eyes (as is done ordinarily by myopes in order to diaphragm the pupil) but by keeping the eyes wide open and by making a conscious effort which reduces the power of their eye and is equivalent to a negative accommodation. This effort seems fatiguing and quickly produces a sensation of discomfort and stinging in the eye and can be maintained only a few minutes, except after special training. During this state of voluntary tension, visual acuity is sharpened and an objective measure of refraction reveals a transient hypermetropia (or decrease of myopia).

Here are some results of experiments on young emmetropes: the left eye, made myopic by a 3 or 4 diopter convex lens, fixated a visual acuity chart (a) naturally (b) making an effort to see as clearly as possible, while the right eye was examined by skiascopy preventing its fixation. The values follow:

	(a)		(b)
Subject A	0.00D.S. ⌒	+0.50D.C. axis 100°	+2.50D.S. ⌒ + 0.25D.C. axis 180°
Subject B	0.00D.S. ⌒	—0.25D.C. axis 180°	+2.25D.S. ⌒ + 0.50D.C. axis 180°
Subject C	0.00D.S. ⌒	+0.50D.C. axis 120°	+2.25D.S. ⌒ + 0.25D.C. axis 30°

[1]LeGrand, Y., and J. Marandon. Comptes rendus *228*, 1381-1382, April 25, 1949.

The following two subjects, being myopes, needed no correction lens before the left eye:

	(a)		(b)
Subj. D	—4.00D.S. ⌒ —0.50D.C. axis 180°	—1.25D.S.	⌒ +0.25D.C. axis 180°
Subj. E	—5.50D.S. ⌒ —0.50D.C. axis 180°	—2.75D.S.	⌒ —0.25D.C. axis 90°

It is seen that in every case the effort which improves visual acuity is accompanied by a reduction of power of the eye between 2 and 3 diopters, and by a change of astigmatism. The cornea remains unchanged. This variation of astigmatism proves that the phenomenon has its origin in the lens (and not in a reduction in length of the eyeball by the action of the extrinsic muscles).

These results seem to us to have only two possible explanations: First, it may be a matter of negative accommodation, that is of a flattening of the lens beginning with the equilibrium form which corresponds to the far point, instead of the curvature which is produced at the time of the usual positive accommodation, and in this case (a) represents the far point and (b) a negative near point. Secondly the effort of focusing may yield the true far point (b), while the ordinary refraction (a) corresponds to a residue of accommodation (latent hypermetropia or tonus of the ciliary muscle). This second hypothesis may be eliminated thanks to the results obtained under cycloplegic. Thus a partial paralysis by homatropine gives the following results:

	(a)		(b)
Subject E	—5.25D.S. ⌒ —0.25D.C. axis 180°		—3.87D.S.

Essentially the same far point is found whereas the negative accommodation diminishes. The subject was aware of this, and with great difficulty succeeded only partially in increasing his visual acuity.

As to the origin of this negative accommodation, we leave that to the physiologists. Is it perhaps, according to the old hypothesis of W. Henke, the antagonistic action of the muscles of Rouget and of Brücke?[2] In any case this negative accommodation does not seem general. The author has never been able to confirm it on himself. Note that subjects A to D are young (24 to 26 years) and are not trained. On the other hand, subject E who is older is skilled in the Bates method[3] which, in our opinion, consists in large part of exercises destined to develop negative accommodation although the theory proposed by Bates is different and presumes variations (in our opinion very unlikely) in the length of the eye.

[2]LeGrand, Y. Optique Physiologique, Vol. 1, p. 76, 1946.
[3]Better Eyesight Without Glasses, 1943, 2nd Edition.

CORNEAL LENSES—A SUPPLEMENTARY REPORT*

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The original optometric report on corneal lenses, read before the American Academy of Optometry two years ago, ventured an appraisal of this new type of lens and the place it would come to occupy among the existing means for correcting vision.[1] It will be advantageous to re-appraise these lenses in view of the greatly increased experience with them during the intervening time.

The corneal lens is a diminutive form of contact lens, consisting solely of a thin meniscus of transparent plastic. In wear it loosely and gently caps the cornea. The overall diameter is slightly less than that of the corneal segment; the average thickness is 3/10 of a millimeter and the average weight is 1/10 of a gram. It is by far the smallest type of lens yet developed for correction of vision.

As a result of its minuteness and intimate placement, a corneal lens is practically invisible on the eye. The natural appearance is altered so little that, even when only one lens is worn, there is rarely any detectable difference between the two eyes. The cosmetic effect is almost always completely satisfactory with this type of lens.

No artificial fluid is employed with corneal lenses. A lubricating layer of natural tears always separates the lens from the ocular tissues. Adequate circulation of tears to the cornea beneath the lens can and must occur. One of the principal objectives in fitting is the determination of that lens which permits the optimum tear flow to the cornea beneath it. Lacrimal circulation can be observed under the slit-lamp or demonstrated by instilling a solution of fluorescein above the lens. Because the exchange of tears is combined with gentle and varying pressures against the cornea, significant amounts of corneal clouding rarely occur. The most serious limitation of conventional types of contact lenses has thus been almost completely overcome. As a consequence, the wearing time of the newer lenses is substantially greater than that of earlier

*Submitted on November 30, 1951, for publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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[1]Graham, Robert. The Corneal Lens—A Progress Report. Am. J. Optom. & Arch. Am. Acad. Optom. 26.2.75-77.1949.

types. In 167 random cases which responded to a questionnaire, the average wearing time reported for corneal lenses is above 8 hours. A number of these cases wear their lenses constantly when awake.

The first successful type of corneal lens was invented in 1947 by Kevin M. Tuohy, a staff member of the College of Medical Evangelists in Los Angeles. Since that time over 6,000 cases have been fitted. As a result of this experience, certain generalizations become possible. One of the first questions raised about the new lens has been answered rather conclusively: it has shown itself to be not dangerous or harmful to wear. Minor abrasions in the superficial layers of the corneal epithelium have been known to occur, due to poor fitting or gross abuse in wear, but in no case has any irreversible damage been reported.

The first 100 cases fitted with corneal lenses were carefully checked at intervals under slit-lamp and corneal microscope. Eleven are still undergoing occasional scrutiny. No evidence of permanent tissue alteration has been found, even under histological examination. The two individuals with the longest history of wear are the inventor and his wife. They have worn corneal lenses throughout their waking hours for the past three years. Recent and very critical examinations under the corneal microscope revealed their corneas to be perfectly normal and healthy. The increase in wearing time, which usually comes rather slowly with this type of lens, is evidently due to an adaptive process which does not involve tissue sclerosis. There are no clinical changes evident as the wearing time increases. There is no loss of sensitivity to sharp particles which might enter the eye.

The eight-hour average wearing time spoken of above, while gratifying compared to the experience with preceding types of contact lenses, indicates that corneal lenses still fall short of glasses in average wearability. The majority of corneal lens patients eventually achieve the wearing time they most desire or need, but tend to settle for that, rather than work for the theoretically attainable all day wear. Almost all of those who have corneal lenses still require glasses, to which they revert whenever they choose. Their glasses are usually preferred for reading and other near work, because at such times the advantages of corneal lenses are at a minimum, and glasses are in general rather more comfortable, especially after hours of wear. This comfort differential is the principal reason why real success with corneal lenses is achieved only by patients who earnestly desire them. Such patients have sufficient motivation to master them. Corneal lenses thus are not to be fitted promiscuously. The need for strong motivation limits their successful application to the same general types which were fitted with previous

forms of contact lenses. Most important among these are:

Athletes and other active individuals who need visual correction.

High ametropes (myopes above 3.50 D.; hyperopes above 5.00 D.), whenever the appearance of their strong glasses is detrimental.

Anisometropes.

Irregular astigmats: including those with injured and partially scarred corneas.

Keratoconus cases of moderate degree.

Monocular and binocular aphakics.

Among the types listed, scleral contact lenses may be called for if the upper lid is intolerant of corneal lenses or if significant amounts of cylinder or prism are required in the contact lenses. Other categories in which scleral contact lenses are still indicated include high keratoconus cases, patients with grossly misshapen corneas, and those engaging in violent athletics, particularly if they have prominent eyes.

The theory of fitting corneal lenses is relatively simple, but its practice is exceedingly exacting and time-consuming. The amount of variance which will be tolerated by the eye is often unbelievably slight. Frequently it occurs that two lenses, identical so far as instruments can determine, will be differentiated by the wearer with never a mistake as to which of the two is more comfortable. The fitting of so intimate a device as a contact lens into so sensitive a location as the eye cannot be simple or easy. To achieve the optimum fit when such critical detail is called for is a problem of exceptional nicety.

Although a corneal lens is much smaller than a scleral contact lens, the corneal type is probably not significantly more comfortable to wear. However, the causes of sensation are more superficial and can be adapted to more readily. With the corneal lens the principal sensations arise because the upper lid, in blinking, slides across the upper edge of the lens. Experienced wearers usually find that this gives rise, after some hours, to itching and burning of the conjunctiva which lines the upper lid. This, it should be noted, is a very different matter from the engorgement of the corneal epithelium which produces the temporary clouding of vision characteristic of conventional contact lenses. With corneal lenses there is rarely any clouding, and the average patient's ability to adapt to lid sensations is far greater than his ability to adapt to corneal imbibition. These circumstances, rather than any increase in comfort, account for the substantially greater wearing time.

The corneal lens does not stay in place as securely as a scleral contact lens, but its security is adequate for almost all purposes. Excessive

looseness can usually be corrected. Corneals have been fitted successfully, not only to swimmers, but to wrestlers, boxers and football players. Perhaps the best gauge of their security is the fact that they are insurable against loss for a very insignificant annual premium.

OPTOMETRIC IMPLICATIONS

Corneal lenses substantially increase the degree of success which can be obtained in contact lens cases, but they do not significantly increase the number of genuine contact lens cases themselves. They do not create any new categories in which contact lenses are successful.

Doctors and students of optometry have frequently inquired if corneal lenses now make it feasible for the regular optometrist to fit contact lenses. The inventor of corneal lenses has this to say on the subject: "One cannot learn corneal lens fitting on a few patients. Earlier in our development we trained 150 optometrists in the Los Angeles area to fit corneal lenses. We reluctantly observe that almost all of them, after trying a few cases, are no longer fitting. The work is again being done by the relatively few men who specialize in it." Studied observations attribute this to three factors: One is that the number of authentic contact lens cases in a regular optometric practice is relatively small—about one out of 300 patients (1/3 of 1%). These require only one fitting because, unlike glasses, corneal lenses almost never have to be changed. Another factor is that the fitting of a contact lens into the most sensitive location in the body is a very critical task. Adequate skill in contact lens haptics cannot be gained or maintained with the limited number of cases occurring in a regular practice. The full meaning of this statement can be gauged by considering what would occur to one's skill as a refractionist if he were to fit only two or three pairs of glasses per year. The enthusiasm of many men has cooled with the realization that, on the basis of hours spent, they are at least as well recompensed if the time is devoted to regular refractions.

SUMMARY AND CONCLUSIONS

Although corneal lenses have established themselves as one of the most significant advances in contact lens science, they are found to be in no sense a potential threat to glasses as a visual aid. They are, rather, an adjunct to glasses. The great majority of those with corneal lenses also need glasses and need changes in those glasses as frequently as ever. Corneal lenses supplement regular eye care; they do not supplant it.

The development of corneal lenses has not significantly increased the number of cases in a regular practice which should have contact lenses. It has, however, increased the percentage of successful fittings on

those patients who do qualify as authentic contact lens cases. The improved appearance and substantially longer wearing time of corneal lenses have caused conventional scleral contact lenses to be replaced on most of such cases.

The pronounced decline in contact lens usage just prior to the introduction of corneal lenses was evidently due to dissatisfaction with the performance of the prior types, rather than to transient interest in contact lenses. The revival of contact lens activity since the introduction of corneal lenses is sufficient to show how sincere is the desire of many individuals for a type of correction which provides normal vision together with natural appearance, eye safety and unrestricted freedom of activity for the wearer.

ABSTRACT

ARTIFICIAL LENS USED IN BRITISH CATARACT CASES

Recommended for reading: A paper in *Lancet*, abstracted by Time,* in which Mr. Harold Ridley, London eye surgeon, describes a new approach to restoring vision for patients with cataract. This, briefly, is the technique: In the cataract operation, the cornea is cut and held back while the front of the cataractous lens capsule and lens are removed. Then a plastic lens, ground thinner than nature's lens, is inserted behind the iris and held in place by the back part of the lens capsule. In 22 out of 25 cases the operation "appears to be successful." Of the three failures, two were caused by trying to use a too-thick lens in the effort to match nature's lens, and the third unsuccessful case was that of a very elderly man whose wound did not heal. Twenty of the operations were performed sufficiently long ago to allow vision in the eye to be measured. Results—seven cases normal vision, five cases 20/30 and eight cases 20/120. The plastic lens is focused for distance: glasses are needed for near point work.

*Time, February 2, 1952, p. 38.

VIRGINIA HUCK

HORROR FUSIONALIS WITH AN ALTERNATING INTERMITTENT EXOTROPIA—A CASE REPORT*

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Patient: P. M. M., female, height 5'3", weight 114 lbs., age 22, occupation—legal secretary.§

Chief Complaint: The patient believed that one of her eyes turned out occasionally and this belief was supported by the observations of her friends.

History: Ocular: The last eye examination was about four years ago when the patient was told that her vision was satisfactory. On December 2, 1950, she reported to the Chicago College of Optometry Eye Clinic for a visual analysis. The clinician was able to take only monocular findings and her refractive error did not warrant a prescription. From the battery of visual skills tests, it was only possible to determine the far and near visual acuities. All other tests gave a monocular response. The patient was referred on January 20, 1951, to the Strabismus Research Project for further study.

General Health: The patient's physical condition was normal with the exception of a mild anemia. She had had the usual childhood diseases with no after effects. Her last dental examination revealed several impacted wisdom teeth.

Family: There were no serious familial ocular defects; however, her mother and sister wear glasses. From a heredity viewpoint it is interesting to note that the patient reported her male cousin has a strabismus. The type could not be verified since he lives out of the city.

School: The patient is a college graduate and was first aware of her present visual anomaly while attending high school.

Social and Recreational: She is active socially attending plays and movies frequently. Membership in local organizations include church and sorority.

Report of E. E. N. T. Specialist: The patient consulted an eye physician and was informed that her visual condition was congenital and

*Submitted on September 13, 1951, for publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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‡Optometrist, M.S., Graduate student.
§This case was trained under the direction of Dr. Thaddeus R. Murroughs at the Chicago Strabismus Project.

that she would have to "live with it." She inquired as to the possibilities of visual training and was told it would do her no harm.

VISUAL SKILLS TESTS

1. In testing for simultaneous vision (dog and pig) the patient reported an alternating percept, always monocular. The same report was obtained on all tests for vertical and lateral imbalances at both far and near.

2. In taking the acuity tests it was necessary to occlude the eye not being tested due to the confusion of rapidly alternating percepts. Under conditions of occlusion the acuity at far was O.D. 102% and O.S. 100%. At near O.D., O.S., and O.U. 100% with an alternating percept.

3. In testing for stereopsis (DB-6D) there was alternation with no fusion. Color test responses were normal but alternating.

PRELIMINARY EXAMINATION

Unaided acuity: O.D., O.S., and O.U. 20/15. The patient has never worn a correction or had visual training.

Dominancy: Hand, foot and eye all strongly right dominant.

Color Perception: Normal.

Pupillary Distance: 61/58 mm.—when this measurement was taken the right eye diverged.

External Examination: Negative—Observation of the orbital cavities revealed that the left eye was approximately 2 mm. higher than the right eye.

Ophthalmoscopy: Negative.

ANALYTICAL EXAMINATION

Ophthalmometry:

O.D. 44.25—180
45.00— 90 —.75 x 180
O.S. 44.00—180
45.00— 90 —1.00 x 180

On this basis no anisometropia is indicated.

Retinoscopy:

O.D. +.50 —.50 x 180.
O.S. —.25 sph.

Subjective:

O.D. +.75 sph. V.A. 20/20
O.S. +.25 sph. V.A. 20/20

Best V.A. O.D. +.50 sph. V.A. 20/15
O.S. plano. V.A. 20/15

Unfused Cross Cylinder:
O.D. +2.00 sph.
O.S. +1.75 sph.
Positive Relative Accommodation —5.50 D.
Negative Relative Accommodation +2.50 D.
Phorias and ductions could not be taken due to an apparent central horror fusionalis.

DIAGNOSTIC TESTS

After-Image Test:[1] The right eye was stimulated by the horizontal filament and the vertical filament was exposed to the left eye. The patient reported a lateral homonymous separation of the after-image components of 10 degrees. After a few moments of observation, the after-image components formed a cross.

After-Image Transfer Method:[2] The left eye was stimulated by the vertical streak for 20 seconds; then occluded while the right eye fixated a target, the after-image was reported 9° to the patient's left. This report varied during the observation.

Hole in Hand Test:[3, 4] With the tube held before the fixating right eye and the left hand placed adjacent so as to intersect the visual axis of the left eye, the patient gave a factual response. When the tube was held before the left eye and the right hand placed adjacent so as to intersect the visual axis of the right eye, the response was also factual (a hole seen to the side of the hand).

Two Tubes Test: One tube was placed before the left eye and another of larger diameter with a red filter at the distal end was held before the right eye. The patient looked at a transilluminated screen and was able to superimpose the light circles in a slightly divergent position of the tubes. When the tubes were reversed the performance could not be duplicated!

Patterns of Vision:[4] The patient wore red-green glasses and viewed a white transilluminated screen from a distance beyond 3 M. and reported an alternation of red and green. She walked forward and inside of 1.5 M. and observed a partial mixture of the colors (luster).

Superposition with Mirror:[4] With a hand mirror, superposition of a small side target upon a fixation object directly ahead was attempted unsuccessfully.

Lange Coordinator: A red-blue slide was inserted in the coordinator. At first only red was reported, then red and blue alternately. Upon further questioning it was found that the relative position of the colors could not be determined.

Telebinocular: The Bu 1 card was inserted in the holder, set for

infinity, so that the white dot was on the right. A Russell ring was placed in the patient's left hand and to encircle the dot it was necessary for her to reach over to the right side (a factual response).

Worth Four-Dot Test:[5] With red-green glasses in a darkened room, the patient reported three green and two red dots (showing a simultaneous percept without fusion).

Troposcope: The Bu O slides A and B were inserted and the patient was allowed to manipulate the tubes of the troposcope. At first she saw only the A, then perceived the A and B but could not place them in vertical alignment.

Amblyoscope: The patient was unable to place the bird inside the cage. As the tubes were moved closer to the point of superposition, the bird suddenly disappeared and then reappeared on the opposite side of the cage.

String Test:[4, 6, 7] A white cord 3 M. long was attached to a light source and held to the bridge of the patient's nose. Wearing red-green glasses (red lens O.D.), the patient saw a red string. After a few moments the patient reported two light sources and two diverging strings in heteronymous diplopia.

Vertical Prism Test: While wearing red-green glasses, a square of white light at 6 M. was fixated by the patient. An alternating percept was reported. A 6 D. prism base-down lens over the left eye was used to elicit diplopia. Using the red light as a point of reference, the green light was seen first on the right side and then on the left.

Push-Up Test: Binocular fixation was maintained up to 10 cm. At that point, upon subsequent repetition, either the right or left eye would turn out.

Strabismometry: Prism and Cover Test (Objective) 16 prism diopters base-in.

Tangent Cross (Subjective) 18 Prism diopters base-in. Crossed diplopia—indicating normal retinal correspondence.

Troposcope (Objective and Subjective) 18 prism diopters base-in.

Motor Fields: No paralysis was indicated.

Field Studies: Negative.

Tests using the overhead projector with a large translucent screen. (The patient wore red-green glasses.) Peripheral Stimulation (slides BSM 1, 2, 20): Patient obtained a correct stereoscopic effect of the anaglyph rings and reported correct size changes. Para Macular Stimulation (slides BSM 6, 7, 22): Patient was unable to see one ball and one ring simultaneously. If the ball was single, the ring was seen in diplopia and vice versa. Macular Stimulation (slides BSM 12, 13,

23): Patient reported numbers one, two, three and four in the proper sequence and color. However, she could not perceive the bird stereoscopically.

Chieroscopic Drawings: Patient was unable to achieve replacement projection. Her perception alternated from the master drawing to the blank white paper.

DIAGNOSIS BASED UPON INTERPRETATION OF FINDINGS

Previous history and observation indicated an intermittent, alternating exotropia. Sensorial tests showed an alternation of percepts between normal and anomalous correspondence. The patient demonstrated the presence of peripheral stereopsis, but a decided central aversion to fusion, which is designated as "horror fusionalis." This was in evidence in every instance where macular targets were used for testing.

TRAINING

The treatment consisted of two training sessions per week for seven months. Each session lasted for one hour. These longer training periods were instituted as the patient was very cooperative and had a strong desire to remedy her visual defect.

The appreciation of simultaneous perception was considered basic in this case. This was accomplished by the use of vertical prisms in conjunction with the Arneson Korector and the kaleidoscope. The vertical prism approach technique was utilized to supplement the above procedures. This method involved projecting oblique red and green lines upon a large translucent screen by means of the overhead projector. The patient, wearing red-green glasses, stood at 6 M. holding a vertical prism strong enough to produce a diplopia of the screen.

The patient walked forward until superposition was obtained with simultaneous perception. To vary the target and to introduce a more dynamic stimulus, the above procedure was duplicated using the kaleidoscopic pattern.

Tactual reinforcement of simultaneous perception was brought about by use of the hands in the telebinocular. Chieroscopic drawings were also utilized to attain the above objective.

Mirror superposition was achieved by the use of large targets. The size of these targets was constantly reduced as long as superposition was successfully maintained.

After simultaneous perception was attained on the Arneson Korector and the kaleidoscope, the amount of vertical prism was gradually reduced until superposition was elicited. This fact was established

by the use of red-green glasses, which caused the appearance of the jewel on the korector and the pattern of the kaleidoscope to be a blend of these colors. At this point lateral prism base-out was slowly introduced, as long as the patient could achieve adequately. Further evidence of binocularity was demonstrated when the patient reported the rotating disc of the korector to appear concave and could maintain fusion of the kaleidoscopic pattern through increasing amounts of base-out prism.

To strengthen the binocular pattern, peripheral fusion and stereopsis training was given at this time using the Keystone Overhead Projector and the large anaglyph rings on a translucent screen. After mastering slides BSM 1, 2, 20 smaller rings were introduced for paramacular stimulation (BSM 6, 7, 22). This was followed by central stereopsis which was attempted and later achieved on all the Keystone macular targets.

Continued base-out training on the korector and the kaleidoscope resulted in fusion through 100 Δ base-out prism. The patient was then dismissed for a five-week vacation.

PROGRESS REPORT

Upon returning from her vacation the patient reported watching a play through binoculars with fusion instead of the usual diplopia experienced previous to training.

Retention of the previously learned skills was shown by the fact that fusion through 80 Δ base-out prism was obtained on the Arneson Korector and the kaleidoscope at the first session. At the next session the patient fused through 100 Δ base-out, the maximum she had attained prior to her vacation.

RESULTS

In order to determine the effectiveness of the training procedure, retests were given on various forms of instrumentation which previously proved to be difficult or impossible for the patient.

The following responses were obtained:

After-Image Test—a perfect cross could be seen by the patient under all conditions.
After-Image Transfer—Vertical Streak ½° to patient's left.
Hole in Hand—Patient could see hole in hand.
Two Tubes Test—Superposition attained with large tube before either eye.
Patterns of Vision—Mixture of red and green from 3 M. to 60 cm. (Retinal Rivalry).
Superposition with Mirror—The patient could superimpose two small objects at any distance.
Lange Coordinator—Fusion with mixture of blue and red.
Telebinocular—Can encircle the dot readily without crossing to opposite side.
Worth Four-Dot Test—Four Dots (fusion).
Troposcope—Vertical alignment of the A and B (slides Bu O).
Amblyoscope—Bird easily placed on perch in cage.
String Test—The red and the green strings met at the fixation bulb.

Vertical Prism Test—The reported diplopia changed from heteronymous to homonymous.
Push-Up Test—Converged to 5 cm.
Strabismometry—Eyes straight (0°).
Overhead Projector—Could achieve stereoscopically on peripheral, para-macular, and finest of macular targets.
Chieroscopic Drawings—Achieved replacement projection.
Aniseikonia—No meridional or overall spatial distortion.
Visual Skills Tests—The test for simultaneous perception was successful with some underconvergence. All lateral imbalances (far and near) showed marked exophoria; vertical phorias were normal; and fusion at all points showed four dots fusing into three immediately.
The acuity was 103% O.D., O.S., and O.U. at far and near.
All responses to the binocular stereopsis test were correct.

ANALYTICAL EXAMINATION

It was possible to take a complete analytical examination.

Habitual phoria, distance, 15 exophoria.
Habitual phoria, near, 20 exophoria.
Static retinoscopy O.D. +.50 —.25 x 180
O.S. —.50 —.25 x 180
Dynamic retinoscopy at 50 cm. O.D. +1.75 —.25 x 180
O.S. + .75 —.25 x 180
Subjective O.D. +1.00 sph. V.A. 20/20.
O.S. + .50 sph. V.A. 20/20.
Best V.A. O.D. + .75 sph. V.A. 20/15.
O.S. + .25 sph. V.A. 20/15.
Induced phoria, distance, 15 exophoria.
True adduction 8.
Convergence 18/8.
Abduction 12/1.
Vertical phoria, distance, 1 left hyperphoria.
Vertical duction, distance. R. Supra 3/2. R. Infra 3/1.
Amplitude of accommodation, minus to blur O.D. 7.50, O.S. 7.50, O.U. 7.50.
Induced phoria, through subjective, at near, 19 exophoria.
Unfused cross cylinder O.D. +2.75 sph.
O.S. +2.00 sph.
Induced phoria, through unfused cross cylinder, 17 exophoria.
Fused cross cylinder O.D. +2.25 sph.
O.S. +1.50 sph.
Induced phoria, through fused cross cylinder, 18 exophoria.
Positive relative convergence 16.
Positive fusional reserve 26/10.
Negative relative convergence 18.
Negative fusional reserve 18/10.

Positive relative accommodation —5.00.
Negative relative accommodation +2.75.
Vertical phoria near 1 left hyperphoria.
Vertical ductions near, R. Supra 4/1. R. Infra 4/1.

SUMMARY AND CONCLUSIONS

The original horror fusionalis, alternating percepts, and partial anomalous projection have been replaced by simultaneous macular perception, normal projection, fusion, and peripheral, para-macular, and macular stereopsis.

Lancaster[8] states that one way of treating a phoria is to increase the amplitude of fusion by orthoptics so that the task of adjustment to be made by fusion, though no smaller, is easier because the capacity of the adjusting mechanism is greater. In this case the high exophorias at far and near as shown by the analytical examination have been compensated for by the large amplitude of fusion attained by visual training.

The uneasy feeling accompanied by the fear that either eye may turn out unexpectedly to the embarrassment of the patient has been superceded by an awareness of visual confidence.

It is apparent that the optometrist, merely because the case appears to be difficult, should not necessarily concur with the opinion of others who have rejected the patient for treatment.

With his specialized skill and training in the field of vision, the optometrist will be able to rehabilitate many of these cases and provide them with comfortable and efficient binocular vision through the application of extensive visual training.

REFERENCES

1. Alfred Bielschowsky. "Application of the After-Image Test in the Investigation of Squint." Arch. Ophth. 17:408-419, March. 1937.
2. Frederick W. Brock. "Visual Training." Optom. Weekly. p. 1699, Nov. 16. 1950.
3. A. Cantonnet and J. Filliozat. Strabismus. p. 44. London, England. M. Wiseman & Co., Ltd., 1938.
4. T. R. Murroughs and Joseph S. Shepherd. "Testing the Strabismic Patient." Optom. Weekly. p. 1509, Oct. 12. 1950. and p. 1549, Oct. 19, 1950.
5. Mary Everist Kramer, Clinical Orthoptics. p. 221. St. Louis, Mo., C. V. Mosby Company. 1949.
6. Frederick W. Brock. "Projection Habits in Alternate Squints." Amer. J. Optom. 17:193, May. 1940.
7. E. J. Margaretten. "Developments in the Correction of Squint." Amer. J. Optom. & Arch. Amer. Acad. Optom. 24:477. Oct., 1947.
8. Walter B. Lancaster. "What Is Orthoptics," Journal Amer. Med. Assn. 130:407, Feb., 1946.

THE OPTICAL CHARACTERISTICS OF BEACH BLENDED BIFOCALS*

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The following investigation was carried out in response to students' questions in our course in Mechanical and Ophthalmic Optics and in an effort to answer optometrists' questions concerning the optical characteristics of the Beach Blended Bifocal. It is not the purpose of this report to evaluate the clinical applications of this particular multifocal lens, but rather to establish its optical characteristics through systematic measurement. Previous attempts to determine the optical characteristics of this particular lens have resulted in confusion and quite often unfair criticism of the lens. It is possible through an understanding of how the lens is made and the manufacturer's objectives to better understand the optical nature of this interesting lens.

Beach Blended Bifocals are the invention of Mr. Howard D. Beach, a photographer by profession. Originally his efforts were directed toward producing an aspheric camera portrait lens with an attempt to increase the depth of focus. Mr. Beach, then beyond 60, noticed that he had good vision at distance and also at the near point through his conventional bifocals, but that the other distances were blurred. In an attempt to overcome this zone of blurred vision he made up a pair of aspheric lenses for his own use. The bifocals which he ground and polished for himself provided a correction through which he was able to read at all distances.*

A description of the lens will aid in understanding the measurements which are included in this report. The following is a quotation from the patent covering the lens (1).

"A multi-focal spectacle lens comprising a one-piece lens body of light transmitting and refracting material of uniform index of refraction throughout, and having upon one face thereof a reading zone of substantial area but constituting a minor part of said face, said zone having a substantially spherical curvature formed to give the desired reading addition to the body, said body also having formed upon the

*Submitted on September 15, 1951, for publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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*From a personal communication from Mr. Paul van Drimmelen, co-worker of Mr Beach.

same face thereof and bordering the reading zone, a plurality of intermediate addition curved areas of relatively narrow width arranged side by side and adjoining one another, and of weaker addition power progressively away from said reading zone to provide multi-focal vision zones, the innermost of said intermediate zones adjoining said reading zone and the outermost of said intermediate zones adjoining said one face, the addition curved areas being formed to blend the addition zones gradually into one another and into the remaining area of said face to provide a smooth surface free of abrupt changes in direction joining the reading zone and the remaining area of said face."

From the data obtained it is evident that the aspheric surfaces on the lenses measured were ground and polished on the non-ocular surface of the blank.

The finished blank is presumably produced in many respects in a manner similar to an Ultex blank. In the manufacturing procedure the segment zone or reading zone is located in the center of the blank. The blank and grinding tool rotate about an axis passing through the center of the segment zone. The polished blank is then trimmed and the finished lens cut and edged from the trimmed blank.

In order to present these data it is necessary to visualize the complete blank and to consider the powers in what will be called radial meridians, i.e., meridians passing through the center of the segment in all directions. A second set of readings will represent the powers in a series of annular meridians which are normal to the radial meridians. The annular meridians are concentric with the center of the segment area. (See Figure 1). This system of meridians is identical with the

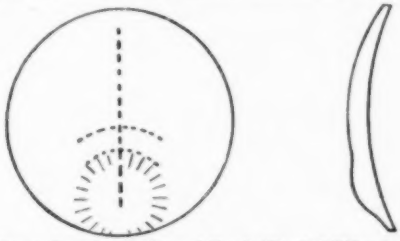

Fig. 1. Non-ocular and sectional view of Beach Blended Bifocal. Dotted lines represent meridians in which powers were measured. Straight line—radial meridian. Curved lines—annular meridians.

lines of latitude and longitude used in the coordinate system on the surface of our earth. Hence, the radial meridians are analogous with the lines of longitude and the annular meridians are analogous with the lines of latitude.

In this investigation three sample stock lenses were measured having adds of 0.75 diopters, 1.50 diopters and 2.12 diopters. These lenses had been edged and beveled and had various prescriptions ground on the ocular surface. Prior to the measurements made herein the ocular surfaces were resurfaced so that the distance correction was either spherical or plano. The instrument used to obtain the data was an American Optical Company Lensometer model M603B. The lenses were placed against the lens holder, as is conventionally done, with the ocular side away from the observer. The bottom of the lens rested against the aligning table which in this particular instrument is mounted on a rack and pinion provided with a millimeter scale. The center of the segment was located and placed over the center of the lens holder. The aligning table was racked up until it contacted the bottom edge of the lens. This particular edge had previously been ground flat so that a wide bearing surface was provided. A measurement taken here indicated the full power of the lens through the segment area. The aligning table was racked up 2 mm., this movement being along one of the radial meridians. At this point, a reading was taken to determine the power in the radial meridian and also perpendicular to it in the annular meridian. Subsequent to these two readings the lens was again moved up 2 mm. and two new readings taken. This procedure was carried on until the bottom of the lens was reached. In the normal wearing posi-

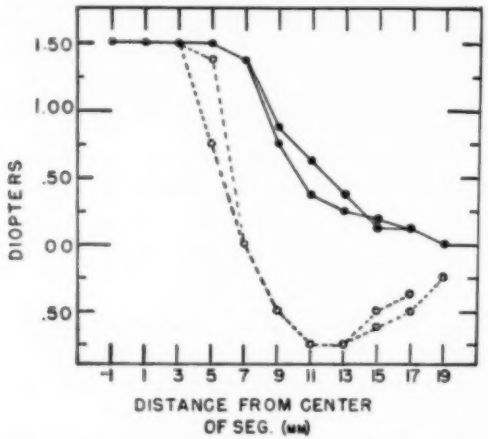

Fig. 2. Dioptric power in a Beach Blended Bifocal with a 0.75 diopter add. Distance correction, plano. Filled circles represent findings in the annular meridians, open circles represent the findings in a single radial meridian. The two sets of data represent readings taken along two different radial meridians.

tion, of course, this would be the top of the lens. Such a series of readings are seen plotted in Figure 2. The powers in the annular meridians at different distances from the center of the segment are plotted by the filled circles and the solid line. The powers at these distances in the radial meridian are plotted as open circles and the dotted line. In Figure 2 two sets of data are plotted, the double sets of filled circles and open circles represent readings taken along two different radial meridians. These data were taken to substantiate the supposition that the lens was symmetrical about the center of the segment. The variations shown are easily accounted for by experimental error. It can be seen that the power in the annular meridians falls off gradually as would be expected in this type of lens. On the other hand, the powers in the radial meridians at the different points from the center of the segment fall off more rapidly than those in the annular meridians. The vertical difference between these two curves represents cylinder power, characterizing the transition zone. This cylinder power is the result of the rapid change of curvature in the transition zone of the lens. In effect the lens has a relatively concave groove between the distance portion and the near portion. This concave groove, annular in outline, is here called the transition zone.

Similar measurements on the two other lenses indicated the same characteristic relationship between these two sets of meridians. However, rather than presenting the curves for the other two lenses, smooth curves fitted by inspection were drawn through the points for each of

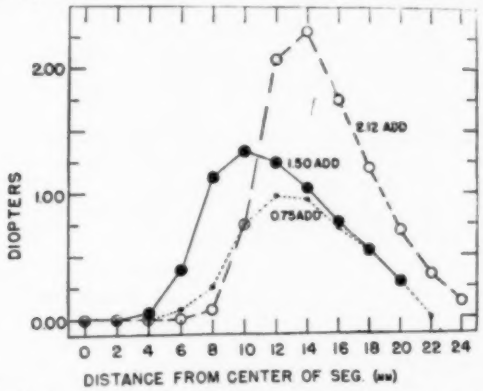

Fig. 3. Cylindrical power at different distances from the center of the segment in Beach Blended Bifocals having adds of 0.75, 1.50, and 2.12 diopters. These readings represent the differences between the readings in a radial meridian and the annular meridian at a given distance from the center of the segment.

the three lenses and the difference between the two curves plotted as shown in Figure 3. The three curves shown here represent the cylinder power present in the transition zone in each of the three lenses. It will be noted that the induced cylinder power increases as the power of the add increases. This is understandable in that the transition groove will be deeper as the power of the add increases. It will be noted that in each of the lenses there is little or no cylinder power up to a distance of 4 to 6 millimeters from the center of the segment. Consequently, the area of the segment roughly 10 millimeters in diameter is free of extraneous cylinder power. From Figure 3 it will be seen that the full power of the add is also present within this area. The cylinder power in the transition zone reaches a maximum somewhere between 10 and 14 millimeters from the center of the segment.

CONCLUSIONS

(1) The Beach Blended Bifocal is a one-piece bifocal surfaced so that in the finished blank the lens itself is symmetrical about the center of the segment area.

(2) In the three lenses measured in this investigation the full power of the add is contained in an area roughly 10 millimeters in diameter.

(3) A transition zone annular in outline surrounds this segment area. The zone is roughly 18 millimeters wide. A certain amount of cylinder power is present in this transition zone. The axis of this cylinder is an annular axis concentric with the center of the segment. The magnitude of the cylinder power present in this zone is roughly equal to the power of the add.

REFERENCES

1. Beach, Howard D., United States Patent Office No. 2,405,989, Aug. 20, 1946.

ANNOUNCEMENT

AMERICAN ACADEMY OF OPTOMETRY COMMITTEE ON CHARTERS AND NEW CHAPTERS

President Harold Simmerman announces the following appointments to the committee on charters and new chapters:

Dr. Lawrence Fitch, Chairman, Philadelphia, Pennsylvania. Dr. O. L. McCulloch, Holyoke, Massachusetts; Dr. Bernard Mazow, Houston, Texas; Dr. Otto J. Bebber, Denver, Colorado; Dr. George A. Parkins, Ord, Nebraska; Dr. Bernard A. Baer, Washington, D. C.; Dr. George W. Keevil, Toronto, Ontario, Canada.

THE NATIONAL BOARD OF EXAMINERS IN OPTOMETRY*

Rudolph H. Ehrenberg†
Granite Falls, Minnesota

It is a pleasure to appear before this group as a representative of the newly formed National Board of Examiners in Optometry. The board had its first meeting this past week in New York City and it is possible to state that as a result of the preliminary work of the various board members, a surprising amount was accomplished.

A new undertaking of this kind must have as its foundation, integrity and sound principles. And in order to escape the pitfalls almost inevitable in the initial stages of such an undertaking, it is well to draw on the experiences of others who have been active in similar work for some time. In this instance, optometry could learn from medicine and dentistry.

In medicine, a national examining board was founded in 1915 and conducted its first examination in October, 1916. From that date and up to and including a June, 1921 test, 11 examinations were given and 26 candidates were certified. Since 1922, the examination has been given in three parts consisting of, part one, a written examination in six basic science subjects, part two, a written examination in five major clinical divisions and, part three, their component subjects or subdivisions.

Parts one and two are given in approved medical schools throughout the country, while part three is given under the direction of local subsidiary boards in 27 centers at times sufficiently frequent to accommodate all eligible candidates. Examinations in parts one and two are held simultaneously in February, June and September and the examination in part three is held in April. A candidate is eligible for part two after passing part one and upon successful completion of the medical course. To be eligible for part three a candidate must have passed the first two parts of the examination, received his degree and have satisfactorily completed an internship of one year in a hospital approved by the Council on Medical Education and Hospitals of the American Medical Association: or have served in a laboratory acceptable to the Board.

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*Read before the annual meeting of the American Academy of Optometry, New York, New York, December 10, 1951. For publication in the March, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. President of the Board. Fellow, American Academy of Optometry.

Studies by this group reveal that there were 6,596 who took at least one of the tests of the National Board in 1950 as compared with 525 in 1922. The trend has been steadily upward.

The medical board has for the past year been making a study of some of the techniques of the objective type of examination, to determine if the objective type of question might be an improvement over the essay type of question, which has been used chiefly in the board's written examination. As an initial step the board is introducing a group of multiple choice questions as a part of the examination in the subject of medicine in the part two tests in 1951; and in pharmacology and materia medica in the part one examinations. These examinations are a combination of the essay type of question and the short answer type of question.

The certificate of the National Board of Medical Examiners is accepted as an adequate qualification for registration by the medical licensing authorities of all 48 states except Florida, Montana, Texas and Wisconsin. It is also recognized by the District of Columbia, the territories of Alaska, Hawaii, Puerto Rico and the Canal Zone. The Licensing Board of Louisiana exempts diplomats of the National Board from the state examination if such candidates have also been licensed in some other state with which Louisiana has established reciprocal relations. Additional examinations are required by some licensing boards. These are oral examinations in Hawaii, Illinois, Rhode Island and Wyoming and a brief supplemental written examination in Maine and Michigan. The Board of Examiners in the Basic Sciences of Alaska, Arkansas, Connecticut, Iowa, Minnesota, Oklahoma, Tennessee and the District of Columbia honor the examination of the National Board and give a qualifying certificate without further examination. The Nebraska Basic Science Board accepts the National Board's examination in most instances after reviewing the answer papers. The diplomats of the National Board are admitted to the final examinations of the Examining Board in England or the Triple Qualifications Board of Scotland and the Conjoint Board of Ireland. The National Board admits directly to parts two and three of its examination: the diplomats of these boards provided they hold a degree in medicine from an acceptable university. Diplomats may also be admitted without further examination to the Mayo Foundation for Medical Education and Research, provided they possess the other necessary qualifications.

In addition many medical schools accept the National Board's Examination as part of their own examination and promotion procedures and other schools recommend that they be taken. Some schools

require students to pass part one at the end of the second academic year and part two at the end of the fourth year. Other schools require only that part two be passed by the end of the fourth academic year. There are a few schools at which those students who voluntarily take and pass the board's examination either in part one or two, are excused from the corresponding final school examination. The requirements for admission to the National Board examination include a standard four year high school course, two years of acceptable college work including courses in English, physics, chemistry and biology and medical training satisfactorily completed in approved medical schools in the United States and Canada.

It should also be pointed out that dentistry has a similar board following the same pattern of operation and accepting certificates in 17 of the various states. With that background it is well to consider the deliberations of optometry in following such a principle. It was first considered in January, 1922, at the first conference to establish optometric standards. The following resolution was presented and accepted.

Resolution No. 6. Central Examination Board. Accepted.

RESOLVED, That it is the sense of this committee that the Department of Education of the American Optometric Association shall, at the next annual convention of the association in Indianapolis, present a plan for the establishment of a central examining board whose function shall be to prepare and grade examinations as a basis for membership in an academy of the American Optometric Association, to be created by the convention.

That the standard of grading of this central board shall be such that membership in the academy shall be considered as prima facie evidence of ability to satisfy the requirements of any and every state board.

That the Department of Education use its best efforts to secure the cooperation of the State Boards to accomplish the following courses of action:

1. The holding of State Board examinations simultaneously in every state in the union.
2. The use of the examinations set by the central examining board by every state board as the basis of their examination in all written work (at their option they may accept the central board's grades).
3. The acceptance of membership in the academy as a basis of reciprocity.
4. The option to the examinee as to whether he desires simply state license or membership in the academy carrying with it reciprocity subject in every case to the final judgment of each board as to whether the applicant shall be granted a license in the particular state under its jurisdiction.

This resolution was presented to the Conference on Optometric Standards by Ernest A. Hutchinson, now President of the Los Angeles College of Optometry, and a member of the American Academy of Optometry.

The intent of this resolution is as sound now as at the time it was drafted. Optometry as a whole must accept the responsibility for this resolution having gathered dust for the last 30 years. By the same token it is evident that optometry's progress as a profession has been slowed. Some may say optometry was not ready for this step

in its evolution: surely that time is past. There has been ample evidence in the optometric press in late years pointing to the need of such a board in optometry. This may or may not have influenced the International Association of Boards of Examiners in Optometry to pass a resolution at the 1950 meeting to have drawn a constitution to form such a board. The report and the constitution were unanimously adopted this past summer at the International Association of Boards of Examiners meeting in New Orleans. A board of seven members was appointed: Dr. Richard Feinberg, Illinois; Dr. Henry Hofstetter, California; Dr. Nelson Abrahamson, Ohio; Dr. Harold Fisher, New York; Dr. William Goyer, Mississippi; Dr. John Uglum, South Dakota; and Dr. Rudolph H. Ehrenberg, Minnesota.

The groups represented on this board are the Association of Schools and Colleges of Optometry and the International Association of Boards of Examiners in Optometry; each working closely with the American Optometric Association. It is their responsibility to take the frame work of this constitution and develop its intent into a vehicle to serve the citizenry of this nation and optometry. This paper is a report of this progress by optometry.

The philosophy of the Board has been well expressed by Hofstetter:

> The National Board is intended to represent an examining body appointed by the highest order of professional organizations and agencies to conduct examinations from the broadest possible point of view, without regard to state boundaries, governmental obligations and political pressures, and with adequate representation from every major area of professional optometric endeavor. It is intended that its examinations shall be so conducted and organized and its purposes so defined as to give honor and valid certification to the successful candidate. In this attempt it shall not seek to cast reflections on the unsuccessful candidate, nor to disqualify him, nor to discredit states that see fit to utilize men of good character who may not have gained the special honor of passing the National Board, nor even to evaluate the quality of education provided by individual schools.

From this statement there are a number of facts that must be taken into consideration and understood by all segments in optometry. They are as follows:

1. The requirements for admission to a national examination and the examination itself would have to be of such high character that each state could and would consider accepting the national examination in place of a part or all of its own examination.
2. The National Board of Examiners has no authority or desire to issue a license to an optometrist to practice optometry.
3. A record of having passed the national examination does not necessarily mean that a state would grant an optometrist a license to practice optometry, because the specific requirements stipulated in the optometry law in that state would have to be met.
4. Even though an optometrist passes the national examination

he will have to obtain a license to practice optometry as a registered optometrist in each state in which he wishes to practice as such.

5. It will be necessary for the optometrist to pay the license fee in each state in which he secured a license to practice and satisfy any and all requirements of the State Board of Examiners of that State.

6. It may be necessary for some states to amend the optometric practice act to give the Board of Optometric Examiners authority to accept the national examination in lieu of their own.

It is the intent of your speaker to briefly consider the essence of these points.

To qualify for the examination the person must be of good moral character and an advanced student or graduate of an optometric school or college providing a five year course and accredited by the Council of Education and Professional Guidance of the American Optometric Association. In view of the examinations being divided into three sections, it should be explained that in the first year of the Board's examinations, the senior student would be required to take each of the sections. In succeeding years the first section may be taken and passed at the conclusion of the fourth year in school. This, in the future, may contribute to better optometric education as it will lessen the student's feeling of the necessity to place state board examinations above regular course study.

The subject matter is as follows: Section 1, a written examination in the non-clinical subject matter of ocular optics, general physiology, ocular physiology, theoretical optics, geometric optics, anatomy and physical optics. Section 2 will be a written examination in the clinical subjects of theoretical optometry, ocular pathology, physiological optics, practical optometry, optometric ethics and economics. Section 3 shall be an entirely clinical and practical examination in refraction and visual analysis, perimetry, orthoptic procedures, neutralization and duplication, frame bending and adjusting, ocular pathology, contact lenses and aniseikonia.

The examinations will be held in the various colleges and properly monitored by personnel appointed by the National Board of Examiners. The time will be so scheduled as to consider the matter of time zones.

That the National Board of Examiners for Optometry is without authority to grant a license is self-evident. One need only consider the principle of "states rights." According to Article 10 of the Bill of Rights "The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people." The power of licensure in the various

professions is not delegated to the United States by the Constitution, therefore, it is reserved to the states.

A casual review of the various optometric laws show a great variance in these. Some of the laws are so worded that by board rules, the particular state may elect to accept the examination of the National Board. In other states this is not possible: it would require an amendment to the present law to accomplish the acceptance of the findings of the National Board of Examiners. It has been possible for a number of the states to already indicate their confidence in the principle of the national examinations in optometry, by a resolution that makes it permissible for those states to accept the examinations of the National Board. One state is preparing to enter the legislature of their state to make it possible for them to accept the findings of the National Board. But the number of states is still small. Despite this, examinations will be held in the Spring of 1952, for it is felt by the board that certain states will understandably be disposed to accept the results after they have observed the methods of examination, quality of the examination and the manner in which the examinations are conducted. Also it makes better sense to legally accept a body that is functioning rather than a proposed one. It is the speaker's forecast that in not too many years most optometric legislation will include the necessary provisions.

As time passes and the responsibility of the board is proven, perhaps methods may be established in which the schools will utilize the marks of the National Board in lieu of their own, as is the case of medicine. When such is accomplished optometry will have moved another step forward, academically and sociologically.

ANNOUNCEMENT

AMERICAN ACADEMY OF OPTOMETRY ORTHOPTIC SECTION

A special committee for the purpose of evaluating diagnostic procedures in heterotropias has now been appointed by President Harold Simmerman and chairman of the section, Dr. J. Donald Kratz. The committee is as follows:

Dr. Thaddeus R. Murroughs, Chairman, Northern Illinois College of Optometry, Chicago; Dr. I. W. Kinsey, Alliance, Ohio; Dr. Walter Brown, New Bedford, Massachusetts; Dr. Max Schapero, Los Angeles College of Optometry, Los Angeles, California; Dr. Daniel Woolf, School of Optometry, Columbia University, New York City.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 29 March, 1952 No. 3

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Annual Subscription, United States and Canada, $6.00 in Advance: Foreign, $6.50: Single Copies 60c.

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to Dr. Carel C. Koch, Secretary of the American Academy of Optometry.

Published Monthly by the
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B.O.A. ACQUIRES PERMANENT HEADQUARTERS BUILDING

A new 99 year lease, not due to expire until the year 2051, has just been signed by the British Optical Association to house its headquarters in London. The British Optical Association is one of the two large examining bodies for optometrists in England and one of the powerful factors in the optometric life of that country.

The B.O.A. has rented its present superb quarters since 1935, but fortunate circumstances have now made it possible for them to get a long term lease on the building thus assuring the association of top flight permanent quarters for the next one hundred years.

The B.O.A. headquarters are located at 65 Brook Street in London in the heart of Mayfair. It is a lovely structure housing the headquarters staff and association office, as well as a beautiful council chamber. Here,

too, is housed the famous B.O.A. optometric and optical library with its many first editions of early scientific optical texts. This library is the largest and finest of its kind in all the world. The building is also the home of the internationally famous B.O.A. optical museum where, on display, are early optical instruments of every kind as well as all 19th century refractive apparatus. The B.O.A. museum has also a priceless collection of prints dealing with early optics and spectacles and is famous for its collection of 16th and 17th century spectacles.

The acquisition of this house beautiful as permanent headquarters of the B.O.A. is a milestone in the progress of optometry everywhere. It sets a standard of optometric organizational advancement, not only in England but in all countries, and merits our sincere and heartiest praise.

As U.S.A. optometrists, we do not envy our British colleagues their problem with National Health Service, but we frankly admit optometry in the U.S.A. would be better served if a similar optometric headquarters could be established in Washington. Perhaps the success of the B.O.A. will spur the A.O.A. into serious consideration of a similar all inclusive headquarters for optometry in our capital city. Such an A.O.A. headquarters building in Washington would serve as a focal point for optometric activities as well as a rallying point for the profession in the trying years ahead.

We congratulate the leaders of the B.O.A. on their foresight and excellent management which made their permanent home possible. On its present basis the B.O.A. headquarter house in Mayfair, London is a splendid tribute to British optometry.

CAREL C. KOCH

PUBLISHER'S NOTICE: A special subscription unit has been in operation for months to assure subscribers in military service of receiving their individual copies of this magazine each month. Military subscribers are urged to immediately forward changes in their military mailing addresses, giving name and rank, service unit, hospital, camp, naval port or air force base. Also send old address. Journals will be individually forwarded to men in service irrespective of the number of month-to-month address changes which occur.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

MIAMI BEACH AND THE A.O.A. CONGRESS

With the Minnesota mercury hovering at —18° as we write, it seems as good a time as any to talk about the coming A. O. A. Congress in Miami Beach, Florida, next June. In fact, as your reporter has just returned from Florida on a writing assignment, she feels more than qualified to tell A. O. A. members that Miami Beach lives up to all the superlatives their Chamber of Commerce dreams up for press releases. For those who have never been to Florida it will be a unique experience to see the results of the feverish building activities the past few years on this one-time sandbar on the Atlantic. Anyone who hasn't been there since about 1945 will hardly recognize the city. Dazzling white, or pastel stuccoed hotels and motels fill almost every foot of beach for miles up and down the beach. Each has tried to outdo the other in splashiness and splendor, and famed Collins Avenue (Hotel Row) now claims a concentration of glamorous hotels equal to none in the world. The very blue sky, the bright sun, ocean breezes and the fishing, swimming and boating make a combination perfect for a Summer A. O. A. Congress. As for the temperature, the Floridians assured us that June is warm, but not hot, and the ocean breezes keep Miami Beach cool and pleasant.

ANTI-FIREWORKS LEGISLATION

The Fourth of July seems a long way off right now, but those interested in anti-fireworks legislation feel that now is none too soon to work for passage of such laws through Congress. Members of the American Optometric Association and societies for the prevention of blindness are writing Congressmen urging passage of pending bills H. R. 4528 and H. R. 4675 which would prohibit the interstate shipment of fireworks in violation of state laws. The Congressmen serving on the Judiciary Committee, Subcommittee No. 3 which is considering this legislation are Joseph R. Bryson, South Carolina, chairman; Robert L. Ramsay, West Virginia; Edwin E. Willis, Louisiana; Byron G. Robers, Colorado; Chauncey W. Reed, Illinois; J. Caleb Boggs, Delaware; Shepard J. Crumpacker, Jr., Indiana; Claude I. Bakewell, Missouri. Eye specialists active in working for the passage of these

anti-fireworks laws suggest that all optometrists write this committee *now*.

FUTURE ENROLLMENT IN OPTOMETRIC COLLEGES, A MATTER OF CONCERN

The problem of getting high caliber students for our optometric colleges is a continuing one for our educators, no matter what the times, but it is perhaps more serious than usual for the coming October term. Inflation and the need for military manpower are forcing our enrollments down, just at a time when an increasing public consciousness of the value of eye care is creating a demand for more trained professional people.

One aid, we feel, in helping our educators meet this situation, is for every practicing optometrist to keep the problem in mind, and whenever and wherever possible, encourage an eligible candidate to enter the profession of optometry. Between now and October many opportunities will present themselves for the discussion with high school and college students of the advantages our profession has to offer. Take time out, and tell these students about the worthwhile and satisfying career optometry affords, and do everything possible to get these prospective optometrists enrolled in either the pre-optometric or professional courses. The time to discuss this matter is now, as the final decision will be made during the next several months. Any of our schools will be happy to send bulletins to applicants proposed by optometrists.

CAMPUS NEWS

Fall semester graduates of *Chicago College of Optometry* heard Dr. Rudolph H. Ehrenberg, president of the National Board of Examiners in Optometry, outline the plans and objects of the board at their commencement exercises in February. Those graduating were the last of the four-year curriculum group at Chicago College.

Pennsylvania State College of Optometry will hold its annual Graduate Conference in Philadelphia June 2-6, 1952. New features of the conference include a series of nine lectures by different faculty members on modern handling of optometric patients, and a series of three lectures on the glaucomatous patient.

Dr. Richard Feinberg, Dean of *Northern Illinois College of Optometry*, recently addressed the members of the Student Optometric Association, *School of Optometry, The Ohio State University*. His subject was "General Aspects of Optometry."

Los Angeles College of Optometry is offering a special review course

for those wishing to take state board examinations, May 26 through July 3, 1952. Tuition for the course is $83.00; registration may be made any time prior to May 26 by writing Dr. Monroe J. Hirsch at the College, 950 West Jefferson Boulevard.

Dr. W. R. Cramer, president, *Southern College of Optometry*, has announced plans for the construction of two new buildings for the college on a new site at 1240 Union, Memphis. Property recently purchased makes a plot 675 feet from Union to Madison. An architect toured the West Coast in February to inspect other optometric colleges before making final plans for the new college building and clinic. Critical materials for the proposed new clinic have been government approved and construction is expected to get under way in about two months. The president estimates the total investment will be about $600,000.00—$140,000.00 for the land, $100,000.00 for the clinic, and between $300,000.00 and $400,000.00 for the college building. The clinic will be a single story building with about 10,000 square feet; the college building, two stories, with about 30,000 square feet, according to present plans.

A. O. A. FORUM ON VISUAL PROBLEMS IN SCHOOLS

We wish we had more space to devote to a review of the highly successful A. O. A. forum on visual problems in schools held in February in Cleveland, for the program merits several pages. But we have to be content to report briefly that more than 175 optometrists from 21 states and 600 teachers attended; more than 30 speakers representing optometry, ophthalmology, education, psychology and lighting discussed the problem of the welfare of the *whole* child, and although obviously many different opinions were expressed, an interprofessional harmony was decidedly present. This forum, which gains more success each year (it was started five years ago), was planned this year under the direction of Dr. Lois B. Bing, Cleveland, general chairman. Dr. Mervyn H. Kauhl, Cleveland, was in charge of the Saturday annual reading conference sponsored by the Northeastern Ohio Chapter of the American Academy of Optometry; Sylvester Guth was chairman of the program put on at Nela Park, General Electric Company, Friday afternoon.

Speakers from the eye care field included Dr. V. J. Ellerbrock, Columbus; Dr. Franklin M. Foote, executive director, National Society for the Prevention of Blindness; Dr. Marguerite Thoma Eberl, Milwaukee; Dr. T. R. Murroughs, Chicago; Dr. Irving P. Filderman, Memphis; Dr. Earl H. Ridgeway, Trenton; Dr. James Wahl, Anna, Illinois.

BOUQUET FOR MACCRACKEN

The recent hassel between the Office of Price Stabilization and optometry ended, as is already known, in a victory for the profession. What hasn't been told is the fine job done in our behalf by Mr. William P. MacCracken, A. O. A.'s Washington attorney, who laid the groundwork for the ultimate disposition of the matter through a long series of conferences with O.P.S. officials. Again optometry congratulates Mr. MacCracken for the fine work he is doing.

B & L POLICIES DEALING WITH OCCUPATIONAL VISION

In the effort to strengthen the established channels of distribution of glasses the Bausch & Lomb Optical Company has recently announced that all corrective-protective safety glasses will be delivered and invoiced only to optometrists, ophthalmologists, dispensing opticians and established health departments in industry where professional men are in charge. These safety corrective glasses will not be invoiced direct to industry or industrial workers.

RESOLUTION TO CURB LONG STANDING ABUSE

The Executive Committee of the Optical Manufacturers Association, New York City, has adopted resolutions opposing the principle of making cash contributions for the purpose of defraying entertainment expense at optometric conventions. This resolution is long overdue as many manufacturers often have been pressured into this expense which served little or no useful purpose. The Association also has gone on record against advertising in souvenir and program booklets.

COMING EVENTS

March: Conference on Better Production Through Lighting, Vision and Safety, co-sponsored by the Greater New York Safety Council, the Illuminating Engineering Society, the New York University Center for Safety Education and the Westchester County Optometric Society, March 26, Roger Smith Hotel, White Plains, New York. Occupational Vision Seminar, Northern Illinois College of Optometry, March 30, 31, at N. I. C. O.

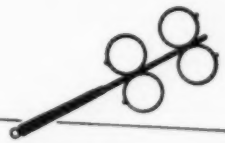
April: Minnesota Optometric Association, Hotel Radisson, Minneapolis, Minnesota, April 20-22. Ohio Valley Optometric Educational Congress, Sheraton-Gibson Hotel, Cincinnati, Ohio, April 20-22. Eastern States Optometric Congress, Hotel Statler, New York City, April 19-21. Tennessee Optometric Association, Hotel Peabody, Memphis, April 27-29.

May: South Carolina Optometric Association, Ocean Forest Hotel, Myrtle Beach, May 19, 20.

How to Get the Most Out of Refracting Room Time

1 ASK THE PATIENT THESE SYMPTOM QUESTIONS

a. Do you work under fluorescent lighting?
b. Do your eyes tire more quickly indoors?
c. Do TV or movies bother you?
d. Notice any discomfort symptoms before watching television?
e. Are your eyes light-sensitive in other ways?



2 IF GENERAL PURPOSE ABSORPTION IS INDICATED THE TCA IS HELPFUL

a. Have the final correction in place before the eyes
b. Explain that you are making this additional test for light sensitivity
c. Ask patient, "Is this better (white lenses) — or this (Soft-Lite #1 or #2) — or this (Soft-Lite #2 or #3)"
d. These answers, plus other case history data, will indicate shade best suited.

3 IF SPECIAL OUTDOOR LENSES ARE NEEDED . . .

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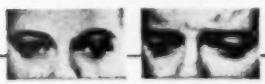

some eyes cannot

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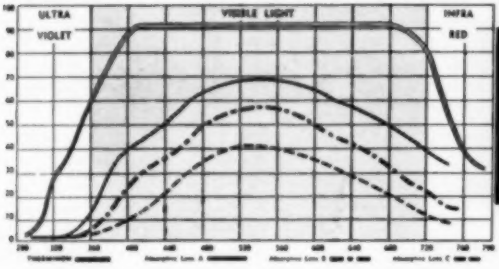

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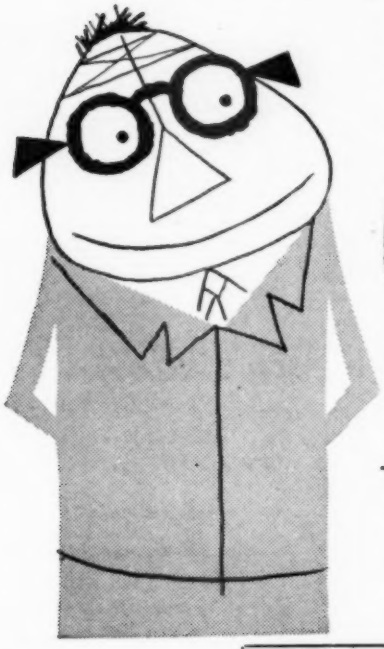

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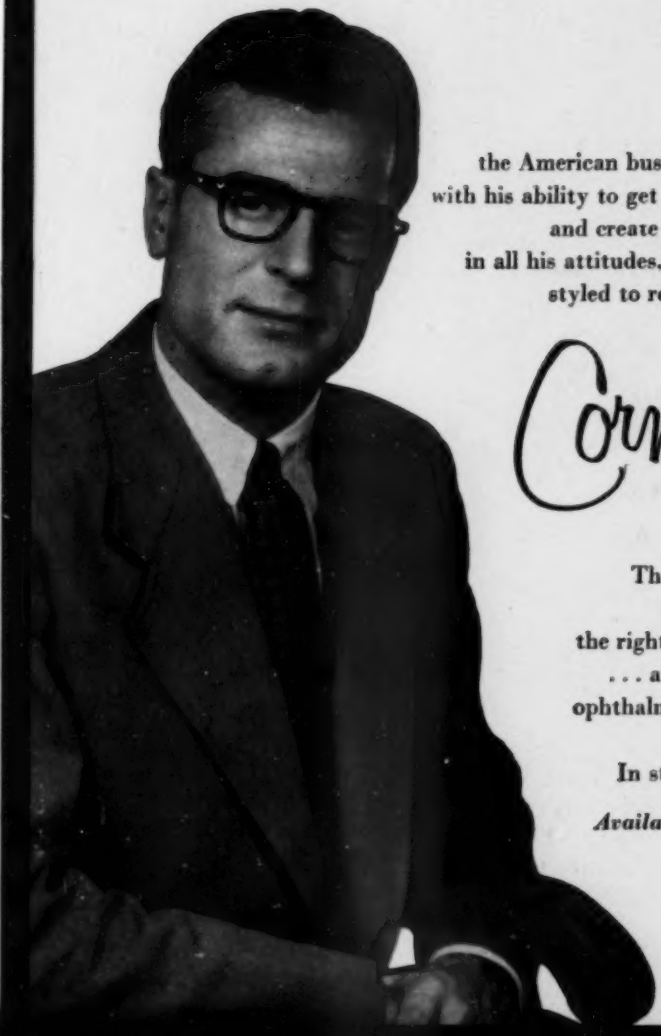

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